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Prizes for Shop Kink Competitors

It is with profuse apologies that the judges have handed us the decision in the Shop Kink competition, which closed March 15. The delay was due to the exceptionally large number of kinks which were submitted by the 15 contributors. J. C. Brekenfeld, of the St. Louis & San Francisco, at Springfield, Mo., was awarded the first prize of $50, and R. S. Mounce, formerly assistant to the general foreman of the Erie Railroad, at Cleveland, Ohio, was awarded the second prize of $25.

Result of the Safety Competition

The first prize in the Safety, or Accident Prevention, competition, which closed June 1, has been awarded to W. T. Gale, shop demonstrator of the Chicago & North Western shops at Chicago. The article will be published at an early date. Friends of Mr. Gale will also be delighted to know that he was elected chairman of the executive committee of the International Railway General Foremen's Association, which has just held its annual convention at Chicago. The several other contributions to the competition have been accepted.

Win a Prize of Twenty-Five Dollars

As a basis of the second shop practice competition, the winner of which will receive a prize of twenty-five dollars, we have selected the subject of repairs to piston heads, piston rods and crossheads. This was announced in both the June and July issues, and the competition closes on September 1. On reading this, you will still have sufficient time to prepare the article and have it reach us before the closing date. We do not desire a finished composition, simply give the necessary facts in connection with your method of making piston packing, machining piston heads, machining or grinding piston rods and machining crosshead bodies and gibs, furnishing photographs or drawings, or both, and including information on the time required for each operation.

Maintenance of Boiler Tubes

Last month L. R. Pomeroy told how the boiler tubes could be handled through the shop at a minimum of time and expense. An ideal arrangement of tools was suggested, and the best types of machines for the purpose were described. The article on the Care of Locomotive Boiler Tubes by Mr. Hedeman in this issue, supplements Mr. Pomeroy's article and considers the best materials to be used for the tubes, safe-ends and ferrules, and also tells how the flues should be renewed, applied and maintained. We hope that our readers may secure much benefit from these articles. It is possible that you may be able to suggest improvements in some of the details. If so, we shall be delighted to have you write and tell us about them, for the subject is such an important one that we should like to get the most advanced and best practice placed thoroughly on record before leaving it.

Mallets for Yard Service

When the very long and heavy trains that are being handled over the road by the modern freight locomotives arrive at the classification yard, it is generally necessary to divide them in several sections to permit the yard locomotives to push them over the hump. At some points practically all of these trains are completely reclassified and the organization and arrangement is such that there is no necessity for stopping after the train is once started over the hump. In these cases a locomotive capable of handling a long train as it is brought in the yard will greatly facilitate the work and therefore the train movement in general. Such a locomotive has recently been delivered to the St. Louis, Iron Mountain & Southern, being the first

instance of the purchase of a Mallet locomotive strictly for yard service. In studying this design the question arises as to the advisability of the application of engine and trailer trucks to locomotives for yard service. The average weight per axle is less than 50,000 lbs. and would be but little over 54,000 lbs. if the two trucks had not been applied. This would not seem to be sufficient increase to forbid the obtaining of from 8,000 to 10,000 lbs. more tractive effort from the same boiler. Since this locomotive will be started and stopped frequently, a semi-automatic starting valve has been applied which admits live steam to the receiver pipe on opening the throttle and automatically closes the communication when the receiver pressure reaches its normal point. Arrangement is also made in this construction to permit the opening of this valve at the will of the engineer, but at the same time it forbids the obtaining of a pressure in the receiver pipe greater than that which has been previously determined to be suitable. In other words, it is impossible to get full boiler pressure in the low pressure cylinders.

Brick Arches and Hard Coal

One of the anthracite burning passenger locomotives just received by the Delaware, Lackawanna & Western, is fitted with a sectional brick arch carried on the usual arch tubes. This is probably the first instance of a brick arch of this type being fitted to an anthracite burning locomotive and its service will be watched with much interest. In the earlier Wooten fireboxes, which included a combustion chamber, there was a brick wall erected at the back of the combustion chamber proper. In this case, however, the firebox does not include a combustion chamber and the arch extends diagonally upward and backward from the flue sheet in the same manner as in a soft coal firebox. At various times attention has been drawn in these columns to the value of an arch considered as a baffle wall only. It is for partly this purpose that the arch has been applied in this case. It is not expected that it will very greatly improve combustion, but that it will improve the efficiency of the firebox heating surface and increase the capacity of the boiler proportionally. When an arch is installed, the back of the crown sheet and the upper back corners of the side sheets, as well as the door sheet, are permitted to transmit as much heat as the other parts of the firebox, which is not the case without the arch. Since the heating surface at this point is practically eight times as valuable as in the flues, the importance of using it to the best advantage is evident. At the same time the improved circulation given by the installation of the arch tubes and the protection of the boiler tube ends by the arch are features that influenced the decision to apply one in this case.

General Foremen's Association

At last, under an aggressive leader, surrounded and backed up by several hand workers who have been actuated by a strong belief in its possibilities, the International Railway General Foremen's Association has demonstrated by the work of the past year, and especially by the convention which was held in Chicago last week, that it is to be a strong, effective organization in a class with the Traveling Engineer's Association, and close on the foot steps of the two larger mechanical department organizations. Mechanical department officers are asked to carefully examine the report of the proceedings in this issue with a view to seeing whether it will not be to their best interests to affiliate with it. The association has unfortunately been badly handicapped by its name. Its function, as its present leaders see it, is to study and make recommendations concerning shop and engine house equipment organization, operation and practices—things that mechanical department officers generally are vitally interested in, and to which the two leading mechanical department associations are in position to devote very little time and attention.

Because of its name—General Foremen's Association—many of the master mechanics, shop superintendents, etc., have apparently felt it beneath their dignity to join, and possibly, with some justification, for until recently those in authority in the association did not seem to have a very big, or a very broad conception, of its work. However, that time seems to have passed. It was undoubtedly no passing thought, but rather a deep conviction of the value of this association, which made H. T. Bentley, president of the Master Mechanics' Association, mention the advisability of having it assist the large association, in his presidential address last June. And, by the way, did you ever hear of a superintendent of motive power or mechanical engineer who held aloof from the Master Mechanics' Association because its name was such that he might belittle himself by joining it?

Several things made the recent convention a memorable one: In the first place W. L. Park, vice-president and general manager of the Illinois Central, who during the past year has so successfully guided his way through a most serious difficulty involving the shop employee, made an address in which he spoke frankly and to the point on the labor problem. In his opinion too much managerial caution has been displayed in the past in dealing with this question and the time has come when it must be met frankly and openly. He did not advocate sweeping the labor organizations out of existence, but rather that they might choose wise leaders, who had the real interests of the men at heart. Things have got to be adjusted on the basis of the Golden Rule and the best interests of both the railways and the men are the same. Neither can suffer without effecting the other. The men in charge of the shops and engine houses are the ones who come into intimate contact with the men, and can do much, if they have a proper appreciation of the possibilities, to get them to see and feel this.

Another thing occurred at the convention which is significant, and that is that the association, after considerable discussion of two important subjects, made positive recommendations—in the first case to the effect that at least 30 days' advance notice of the conditions of all parts of locomotives which were to be shopped should be given to the shop authorities, in order that they might be properly prepared to handle the repairs expeditiously and efficiently; in the second case that shops of 15 pits or over should improve their supervision by the employment of shop demonstrators. It is the duty of such demonstrators to see that the men are properly instructed in operating the machines, or otherwise handling the work, in order to secure the most efficient results. The foremen are too busy with their other duties to give the attention which is necessary to these details.

This year the members were furnished with advance copies of the papers, and the papers themselves were of a much higher grade than those presented at previous conventions. Not a minute was wasted in the discussions. Mr. Pickard in his blunt, direct way, saw to it that the members took part promptly and there was a business-like atmosphere, which was somewhat lacking in previous years. The papers were all good and were all well discussed, although three of them may possibly be considered of more importance than the others, because of the more important information which was brought out in the discussions. The first of these, presented by C. L. Dickert of the Central of Georgia, was really an appendix to the paper on How Can Shop Foremen Best Promote Efficiency, presented by Mr. Reyer. Mr. Dickert's paper, however, dwelt entirely with the idea of furnishing advance information on the engines to be shopped and outlined the way in which this is done on the Central of Georgia. It was as a result of the discussion on W. W. Scott's paper on Supervision, that it was decided to recommend the use of shop demonstrators. The next paper

which attracted considerable attention was that on Roundhouse Efficiency, by William Hall, and so much did the members appreciate the good things developed in the discussion that they asked that a report on engine house work be presented next year. As may be seen the other papers all brought out good discussions and valuable information, and this is particularly true of the one on Reclaiming Scrap Material.

President Pickard deserves a great deal of credit for the success of this year's convention. He objected strongly to his re-election, but the call was so forcible that he submitted, and almost before the convention had closed had several committees organized for next year's work; and to the men who have been honored with these assignments devolves a heavy responsibility to make the reports for next year so thoroughly to the point and so practical that the standards of the association will be placed on a still higher level. And at the same time it is up to the mechanical officers generally—no matter what their titles are—to lend their support. It is not true that at least 75 per cent. of the criticism against the railways in the recent scientific management discussion, which attracted attention far and wide, was directed against the shop operations? Can the superintendents of motive power and master mechanics afford to ignore the one association which is making a business of trying to improve shop and engine house efficiency?

Tool Foremen's Convention

An absence of hesitancy in giving their experiences or opinions on the subjects brought up for discussion has been a marked feature of the conventions of the Railway Tool Foremen's Association. While there were no long prepared talks at any time during the sessions of the last convention, which lasted from three and a half to four hours each, there was no delay or difficulty in getting the members to speak. Everyone seemed to have either information or pertinent inquiry ready for the first opportunity to speak. It is just this spirit that makes associations of this sort of real value and its presence among the tool foremen is one of the strongest arguments in favor of the continued usefulness of the society. While the field covered by the activities of this body is comparatively narrow, it is of sufficient importance to justify the railway companies in permitting their employees to spend the three or four days required each year at the convention, if the members are serious in their efforts to obtain the greatest possible benefit. That they are in this case, cannot be doubted by anyone who attended the recent convention.

Because of the comparatively narrow field, some difficulty is being encountered, even now, in obtaining subjects that have not already been discussed at previous meetings. There would seem to be no objection to again bringing up a subject after an interval of two or three years. In fact there are a number of subjects of interest to this body that are of sufficient importance to justify a standing committee to report each year. The state of the art in connection with tools is advancing at practically the same rate as other mechanical features and this association should aim to keep its members informed on the very latest and most advanced practice. The appointment of standing committees, who will work, is probably the best way of doing this.

It has also been suggested that at each meeting an acknowledged expert on some feature of direct interest to the tool room foreman, be invited to deliver an address. This is a splendid suggestion and it is to be hoped that the executive committee will take it under consideration and next year will arrange to have a talk on the manufacture of tool steel, design of small cutting tools, portable electric tools or some similar subject. Such a talk would preferably be illustrated.

The absence of printed advance copies of the various papers made it difficult for the president to keep the discussion pertinent to the subject and in some cases important suggestions in the papers themselves received no discussion at all. It is recognized that a young association of this kind of comparatively small membership, is restricted in its financial expenditure, and that advance copies of the various papers may be beyond its resources. The dues are at present as high as they should be and there seems to be no way of increasing the income except to resort to the plea for more advertising in the proceedings, which is objectionable for several sound reasons. However, it would seem that some way could be discovered of arranging for the issuing of printed advance copies of the papers without calling on the members individually for greater support. A properly prepared plea to the various railway companies, or possibly to the heads of the motive power departments, for a small contribution to assist in increasing the value of this association would probably meet with a ready response. While this suggestion might be looked on unfavorably at first thought, it is beyond doubt much preferable to approaching a supply company for a similar contribution in the guise of an advertisement.

The spirit that prompted the attempt to have the association make positive and definite recommendations on certain features is to be commended, but in this connection, it should be remembered that the value of any recommendation generally depends on the amount of study and discussion that has preceded its adoption. Furthermore, no recommendation of any association should be made without previously informing all the members that the subject is to be brought up for final decision, at a certain time, thus permiting them to express their arguments for or against it, by letter if need be. Preferably such recommendations should only be made by a vote in which each member has a voice—in other words, by letter ballot. There are a number of features on which the knowledge of the tool foremen is necessary for decision, and recommendations from this association on these points would be gladly accepted and the association, as a duty to itself and the railway companies, should formulate such decisions, but, only as is stated above, after thorough investigation and discussion.

NEW BOOKS

Methods of Analyzing Coal and Coke.—Technical paper No. 8. Written by Frederick M. Stanton and Arno C. Fieldner. Published by the Bureau of Mines, Washington, D. C.

This paper describes the methods used at the laboratories of the Bureau of Mines for analyzing coal and coke and determining the heat value of these fuels. The original methods which were recommended by the American Chemical Society, together with such modifications and changes as have been deemed advisable, are included in the paper. Copies may be obtained by writing to the director of the Bureau of Mines, Washington, D. C.

Walschaert Locomotive Valve Gear. By W. W. Wood, air brake inspector. Published by the Norman W. Henley Publishing Company, 132 Nassau street, New York. 5 in. x 7½ in. 245 pages. 50 illustrations. Bound in cloth. Price, $1.50.

This book is the third edition, revised and enlarged, and is divided into five divisions, the first four dealing with the analysis, design and erection, advantages, and questions and answers relating to the Walschaert valve gear. The fifth division is given over to the setting of the Walschaert gear and a discussion of other modern radial valve gears, including the Hobart-Allfree, the Baker-Pilliod and the improved Baker-Pilliod. This division also includes questions and answers on breakdowns. The history of the Walschaert valve gear is considered and the development of the gear is carried forward in a very simple manner, so that it may be readily understood by the elementary student, as well as those more familiar with the gear. In the design of the gears both the Reauleaux and Zeuner diagrams are con-

sidered. The book will be found valuable by the designers of valve motions as well as by the mechanics who handle this class of work in locomotive shops.

The Effect of Cold Weather on Train Resistance and Tonnage Rating. By Edward C. Schmidt and F. W. Marquis. 24 pages, 13 illustrations. 6 in. x 9 in. Bound in paper. Published by the Engineering Experiment Station, University of Illinois, Urbana, Ill. Bulletin No. 59. Sent free on request.

This bulletin presents the results of tests which were made to determine the increase in resistance of freight trains in cold weather over that which prevails in summer. It shows how great this difference may be in some cases. The tests also show that freight trains must run a considerable distance from their starting point before the minimum resistance is reached. In cold weather this distance may be as much as twelve or fifteen miles. The bulletin presents, in addition, a summary of the practice of American railways in reducing tonnage ratings during cold weather.

Electrical Injuries—Causes, Prevention and Treatment. By Chas. A. Lauffer, A.M., M.D. 77 pages, 4 in. x 6½ in. Bound in cloth. Published by John Wiley & Son, New York. Price 50c.

Injuries of all kinds from electrical circuits are discussed in a clear, simple manner and the proper procedure for first aid in each case is given. The various cases are treated in a logical manner, beginning with an understandable explanation of the effect of the electric shock or flash, followed by an explanation of the object of the treatment, and by a detailed description of the proper method of treating. Instructions are included on the proper way of removing a man who is still in contact with a live circuit, on artificial respiration, first aid treatment for burns, etc. The book is intended for practical men, and the author has consistently maintained this viewpoint. A series of questions at the back of the book will be found useful for preparing examinations on this subject.

The Coal Trade. By Frederick E. Saward, Editor, *Coal Trade Journal*, 20 Vesey street, New York. Price $2.

The 1912 Coal Trade is the thirty-ninth annual handbook covering statistics and conditions in the coal trade. It is a handbook that is essential to those interested in the coal business, and is of value to railway men whose roads carry any considerable amount of coal. A good history of the trade, not only for the whole country, but for the important individual sections of the country in which coal is produced or marketed, is given, and the handbook also includes a great number of short studies on various subjects connected with coal which are very useful as references. The book might be compared to a newspaper almanac, devoted, however, entirely to one subject. The value of such a handbook is affected very much by the kind of index which accompanies it. The index of *The Coal Trade* seems to have been prepared conscientiously and fairly fully.

Cylinder Performance of Reciprocating Engines. By J. Paul Clayton, assistant in the mechanical engineering department of the Engineering Experimental Station of the University of Illinois, Urbana, Ill. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 58.

For many years the only accurate method of ascertaining the steam consumption of an engine has been to measure or weigh in some manner the water used. It has been discovered, however, that the quality of the steam present in the cylinder at cut-off controls the form of the expansion curve of the indicator diagram in a perfectly definite way. From this fact there has been developed a method of computing the steam consumption of an engine from the indicator diagram alone to within 4 per cent. of the actual consumption as measured by test. There has also been developed a method of obtaining the volumetric clearance of a cylinder using steam, gas, air, or ammonia to a degree of accuracy almost as great as the method of filling the clearance space with a known weight of liquid. The bulletin contains an exposition of the methods employed in obtaining the steam consumption and clearance, and also methods of detecting leakage from the indicator diagram with the engine in regular operation.

Electric Traction for Railway Trains. By Edward P. Burch, consulting engineer. Cloth, 583 pages, 6 in. x 9 in., illustrated. Published by the McGraw-Hill Book Company, New York. Price $5.

There has been a demand for a book of this sort in the railway engineering field, both for the technical student and the practicing engineer. The book is not presented in the nature of a popular treatise on the subject, but with the desire to satisfy the wants of the engineer. The first chapter is devoted to a résumé of the history and the present status of electric traction, including tables presenting the general data of roads using electricity in America and Europe. The second chapter concerns the characteristics of modern steam locomotives, giving operating data and diagrams of some of the most recent power. The next two chapters consider the advantages of electric traction and the various systems available, citing the various railways using these systems. The following chapters consider the arrangement and design of the trains and locomotives in detail, giving technical descriptions of the direct current, the three-phase and the single phase locomotives. The way in which power of different kinds may be transmitted and developed at the power plant is considered. Tables are given with operation cost data and information about the equipment for different roads. Throughout the book references are made to articles in the standard engineering journals.

Dynamics of Machinery. By Gaetano Lanza, S. B., C. E. and M. E., Professor Emeritus, Massachusetts Institute of Technology. 6 in. x 9 in.; 246 pages; 137 illustrations. John Wiley & Sons, New York. Price, $2.50 net.

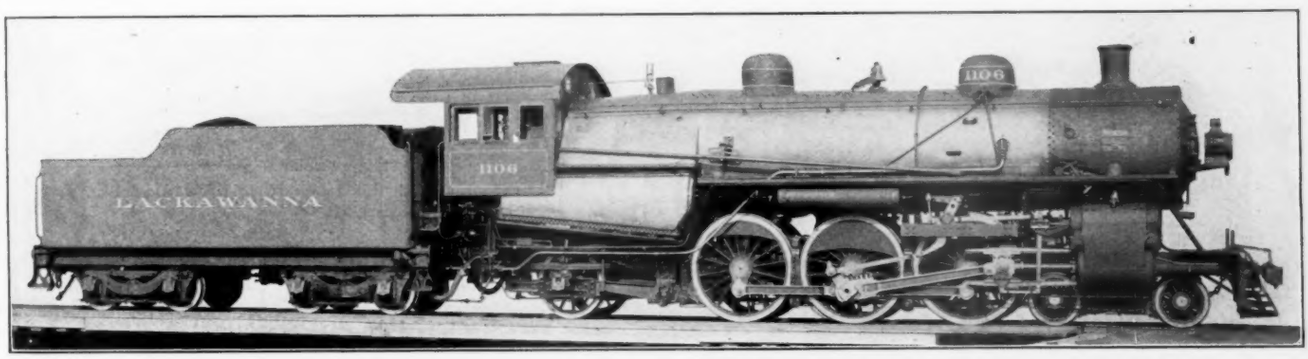
The book is in the form of a text book for students, and is a collection of the more important notes previously used in the course on dynamics of machines given by the author to the senior students of the Massachusetts Institute of Technology. It also contains additional data to make the work more complete. The first chapter describes the different types of dynamometers which are included in the above course. The remainder of the book, however, has for its chief object the methods of dealing with the inertia forces that arise in various kinds of machinery, especially in cases where high speeds are employed. Chapter II contains a theoretical discussion on the moments and products of inertia, and includes practical illustrative examples. Chapter III contains a discussion on the action of the reciprocating parts of a steam and gas engine, and describes the manner in which the formulae are obtained, as well as their use in actual problems. The subject of flywheels, their fluctuations in speed during a revolution and the stresses set up in their rims due to centrifugal force is carefully considered. Diagrams are worked out for the rotative effect of different types of engines. This chapter also discusses the subject of the balancing of revolving masses, giving in detail the problems met with in different types of locomotives. The calculation of stresses in locomotive driving rods is also presented in a theoretical but concise manner. Chapter IV contains a theoretical discussion on the pendulum and flywheel governors, in which the methods used by German scientists have been considered. Chapter V considers the action of bodies moving at a high rotative speed, theoretical treatment being given the moving axis of the symmetrical top, which leads directly to the consideration of the gyroscope. Appendixes cover the discussion of the principal axes and moments of inertia, the deduction of formulae for governor oscillation and the critical velocity of shafting. The book is intended primarily for the use of students, both in and out of school, and is of value to engineers who are doing this class of work.

HEAVY HARD COAL BURNING PACIFICS

The Lackawanna Has Received Seven Powerful Passenger Locomotives That Include a Number of Interesting Features of Construction.

A total weight of 284,000 lbs., and a maximum tractive effort of 40,800 lbs. make the new hard coal burning Pacific type locomotives recently built for the Delaware, Lackawanna & Western by the American Locomotive Company, among the largest and most powerful of this type. They are fitted with Wooten fireboxes for burning hard coal and a brick arch has been experimentally applied to one locomotive. The design throughout is characterized by refinements in details developed with a view of reducing the cost of maintenance. One prominent feature of this kind is the main driving boxes, which are 11 in. x 21 in. Thrust collars have also been fitted to the axles of the engine truck, bearing against the inside of the journal boxes, which will tend to reduce the wear on the wheel hubs and boxes. The front extension of the piston rod, outside steam pipes and screw reverse gear are other features of design which assist in reducing the cost of maintenance and improving operation.

These locomotives have been designed to handle a 460-ton train at a sustained speed of 30 miles an hour on a 1.6 per cent. grade. With the 10-wheel locomotive now in service between New York and Elmira, a six-car passenger train weighing 325 tons is the limit for one locomotive. It is frequently necessary to run seven cars, and helpers are then required through the mountainous districts. The new locomotives are intended to handle 8 cars on the present schedule, and inasmuch as this rating is made on the basis of saturated steam, it is believed that with the reserve boiler capacity secured with the use of highly superheated steam, the locomotives will actually be able to handle nine cars, or 530 tons, over the division without assistance. The ten-wheelers now in use have total weight of 217,000 lbs., a tractive effort of 34,860 lbs., 69 in. wheels, 215 lbs. boiler pressure and 22½ in. x 26 in. cylinders.



Hard Coal Burning Pacific Type Locomotive for the Delaware, Lackawanna & Western.

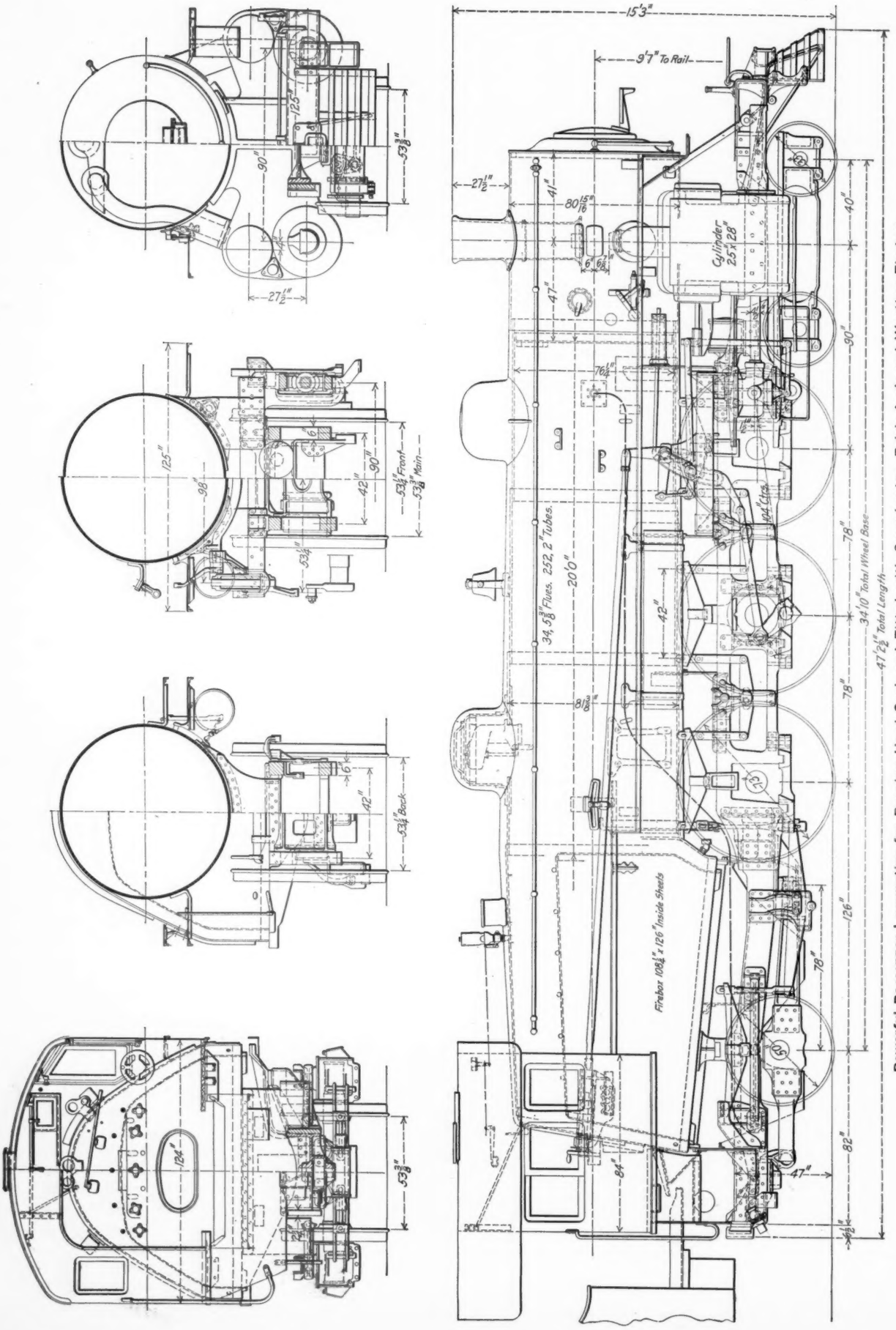
This is another instance in which the modern big locomotive has been resorted to in order to save the expense of double heading in a difficult passenger service which has outgrown the capacity of a lighter class of conventional design. The locomotives are the embodiment of the builder's best ideas in the design and construction of locomotives of their class.

In one of the illustrations is shown the details of the long main driving boxes which also include the use of shoes and wedges over 50 per cent. wider than has been customary. In spite of the extreme length, the arrangement is such that the spring load is equally distributed to all portions of the box and the frames and spring rigging are retained in their normal positions. This device would seem to be the most effective step so far taken to overcome the tendency of the increased horizontal forces set up in the modern powerful locomotive to produce rapid wear and the accumulation of lost motion in the driving journals, resulting in the necessity of frequently renewing bearings. Main driving boxes of this design have been applied to two Pacific type locomotives on the New York Central & Hudson River. From their service thus far, the results have been very satisfactory.

Heretofore, driving boxes have generally been designed with reference only to the weight they support. The size has, therefore, been in direct proportion to the load borne by each journal. This method has not made proper provision for the longitudinal forces, particularly in the case of the large modern locomotive. In the big locomotive of today, the transverse spacing from center to center of the cylinders has necessarily been increased. At the same time, the distances between the frame centers have been decreased to obtain as long a driving box as possible within the limitation of the spacing between hubs imposed by the 4 ft. 8½ in. standard gage. As a result, the horizontal forces have increased in greater proportion than the load borne on the journals. Consequently, while the vertical pressure per square inch of bearing surface due to weight has been maintained fairly constant, the horizontal forces have been increased. This tends to result in the rapid accumulation of lost motion, causing pounding and requiring a renewal of the driving box bearings after much less mileage than theretofore.

Previous efforts to solve the problem have consisted chiefly in increasing the width of the shoes and wedges by making the legs of the pedestals wider than the body of the frame. The disadvantage of this method has been that the increase in the length of the box was possible only by resorting to a lop-sided construction, and experience has shown that it results in the uneven wear of the bearing and conical wear on the journals.

In the device under discussion, the normal width of the frames at the main pedestals is increased by means of auxiliary pedestals on the inside of the frames, combined to form a continuous cross-brace. The width of the shoe and wedge fit is increased by an amount equal to the width of the supplementary pedestal, or that portion of the shoe and wedge bearing formed at each end of the cross-brace which is inside of the frame. The spring load is transferred equally to the center of the box, without disturbing the spring rigging from its normal position in the center of the frames, by the combination spring saddle extending across the engine. Spring seats are



Powerful Passenger Locomotive for Burning Hard Coal, and Fitted with Superheater, Brick Arch and Wootten Firebox.

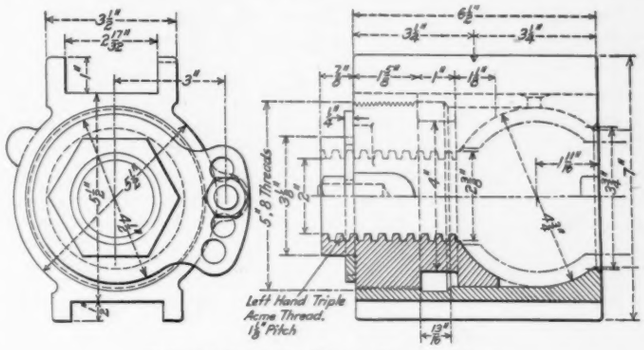
formed in the overhanging ends of the saddle, which in turn is supported by downward extending legs which bear on the centers of the boxes. In the arrangement applied to the locomotives here illustrated, the spring centers are 42 in. apart; while the centers of the legs of the spring saddles are 34 in. apart. The two cross-braces are tied together at the top and bottom by supplementing pedestal caps inside of the frames.

With this device, the necessary length of journal is secured to insure against rapid wear, and the spring supported load is transferred equally to all portions of the driving box without any complications in the design of the frames or the arrangement of the spring rigging. Both of these are retained at about their normal transverse centers.

Another new feature of design, indicating the care with which every detail has been worked out with a view to the greatest efficiency from a standpoint of maintenance as well as operation, will be noticed in the adjustable thrust collars fitted to the leading truck axles on the inside of each box. These serve to distribute the lateral thrust and thereby reduce the wear on the wheel hubs and boxes. Each thrust collar is made in two halves, bolted together, and fits up against a shoulder on the axle. Lateral wear may be easily taken up by babbitting the face of the thrust collar. In order to provide for the easy removal of the oil cellars, the truck pedestal caps are made in the form of links held in place by finished pins and fitted with cotter keys. Thus, by simply dropping the pedestal cap link, the cellar can be taken out from the bottom.

Screw reverse gears are applied to all the engines. This device has also been improved by the use of a ball joint connection between the reach rod and the screw gear crosshead. This obviates the necessity, under ordinary conditions, of offsetting the reach rod to connect to the reverse shaft arm.

In the design of the boiler, the principal feature of interest lies in the fact that one of the locomotives is equipped with the Security brick arch. The boilers of the other locomotives in the order are so designed that the arch can be applied later,

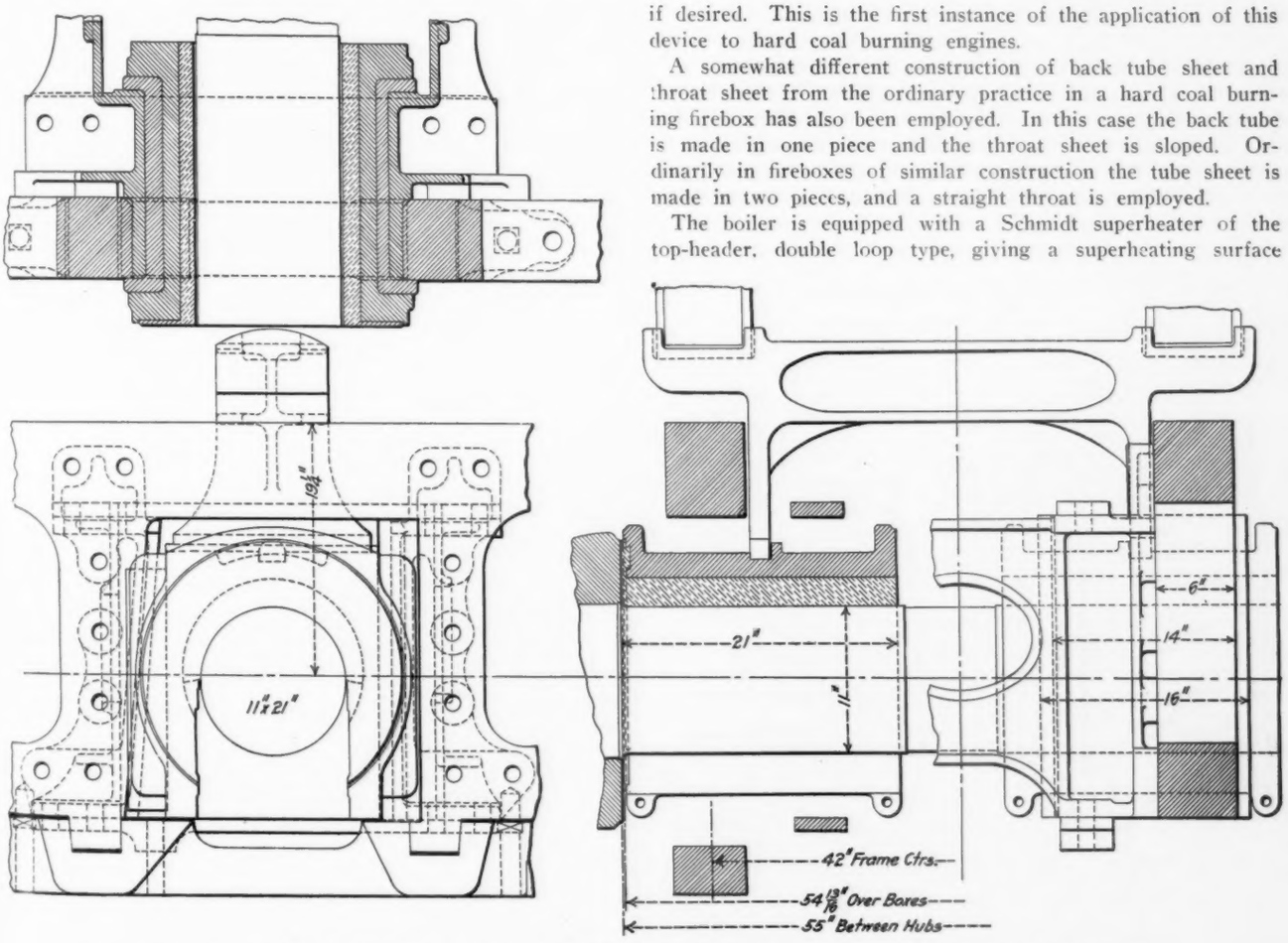


Ball Joint on the Screw Reverse Gear.

if desired. This is the first instance of the application of this device to hard coal burning engines.

A somewhat different construction of back tube sheet and throat sheet from the ordinary practice in a hard coal burning firebox has also been employed. In this case the back tube is made in one piece and the throat sheet is sloped. Ordinarily in fireboxes of similar construction the tube sheet is made in two pieces, and a straight throat is employed.

The boiler is equipped with a Schmidt superheater of the top-header, double loop type, giving a superheating surface of 821 sq. ft., figured on the basis of the inside diameter of the superheater tubes.



Arrangement of the 11 in. x 21 in. Driving Box on the Large Pacific Type Locomotive for the Lackawanna.

Other special features in the boiler construction include the Franklin automatic door opening device. The width of the fire door required a special construction which consists of two pairs of vertical doors carried in a single frame and operated by independent cylinders and foot pedals. Each pair covers one-half the door opening.

Another recent practice will be noticed in the application of

a design of the Walschaert valve gear arranged to give a variable lead. With this arrangement a maximum cut-off in starting is provided with the proper amount of lead at the ordinary running cut-off. This gives a satisfactory steam distribution for high duty service. This practice has been used by the builders in a number of recent designs. The favorable results for starting in full forward gear are, however, obtained at the expense of distortion of the valve events in back motion. For this reason, the practice is suitable for passenger and fast freight locomotives, but not for slow freight or switching locomotives. In the arrangement here employed the eccentric crank is given an angle of advance of less than 90 deg. It thus lags behind its correct position for constant lead and the link is not in its central position when the crank pin is on the center. With the eccentric crank so set, the lead increases from full forward to full back gear.

A new arrangement of flexible connections between engine and tender for the steam and air pipes, furnished by the Franklin Railway Supply Company has also been applied to these engines. It employs a system of ball joints. Vanadium steel is used in the frames.

The general dimensions, weights and ratios are given in the following table:

General Data.

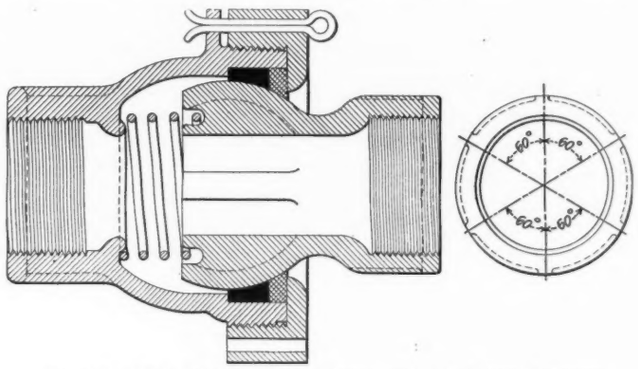
Gage	4 ft. 8½ in.
Service	Passenger
Fuel	Anth. coal
Tractive effort	40,800 lbs.
Weight in working order	284,000 lbs.
Weight on drivers	179,500 lbs.
Weight of engine and tender in working order	443,600 lbs.
Wheel base, driving	13 ft.
Wheel base, total	34 ft. 10 in.
Wheel base, engine and tender	69 ft.

Ratios.

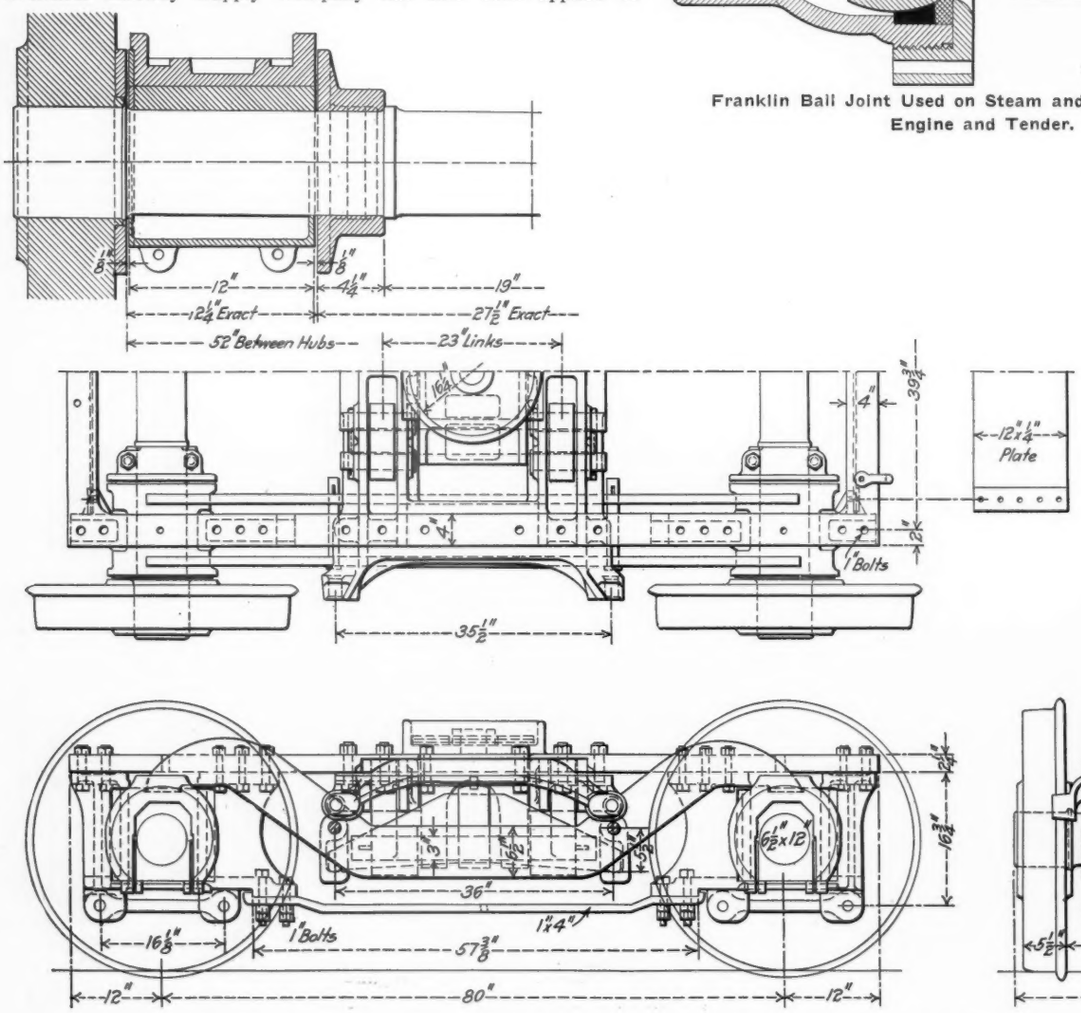
Weight on drivers ÷ tractive effort	4.39
Total weight ÷ tractive effort	6.96
Tractive effort × diam. drivers ÷ equivalent heating surface*	592.00
Total equivalent heating surface* ÷ grate area	53.20
Firebox heating surface ÷ total equivalent heating surface*, per cent.	4.74
Weight on drivers ÷ total equivalent heating surface*	35.50
Total weight ÷ total equivalent heating surface*	56.10
Volume of both cylinders, cu. ft.	15.90
Total equivalent heating surface* ÷ vol. cylinders	317.00
Grate area ÷ vol. cylinders	5.94

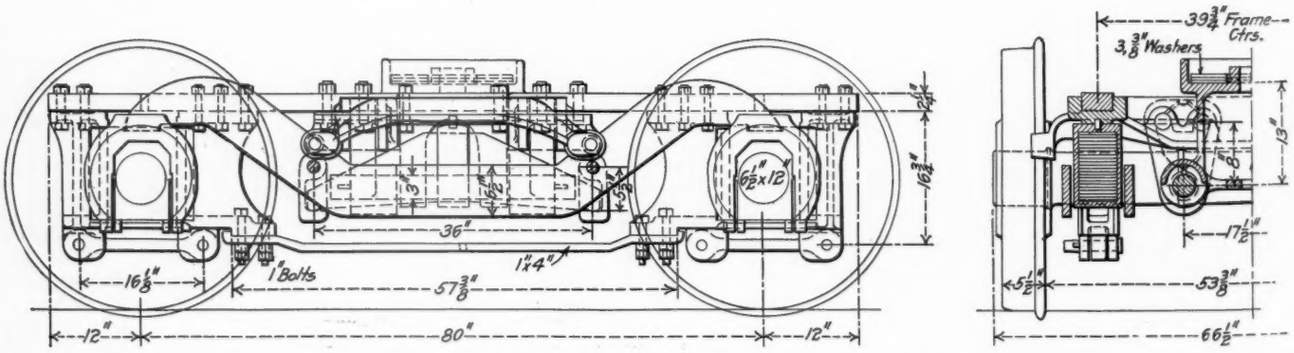
Valves.

Kind	Piston
Diameter	14 in.
Greatest travel	6½ in.



Franklin Ball Joint Used on Steam and Air Pipes Between Engine and Tender.





Engine Truck with Collar on the Axle Inside of the Journal Box; Lackawanna 4-6-2 Type Locomotive.

Outside lap	1⅛ in.
Inside clearance	3/16 in.
Lead in full gear	0 in.

Cylinders.

Kind	Simple
Diameter and stroke	25 x 28 in.

Wheels.

Driving, diameter over tires	73 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11 x 21 in.
Driving journals, others, diameter and length	10½ x 13 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6½ x 12 in.
Trailing truck wheels, diameter	50 in.
Trailing truck, journals	9 x 14 in.

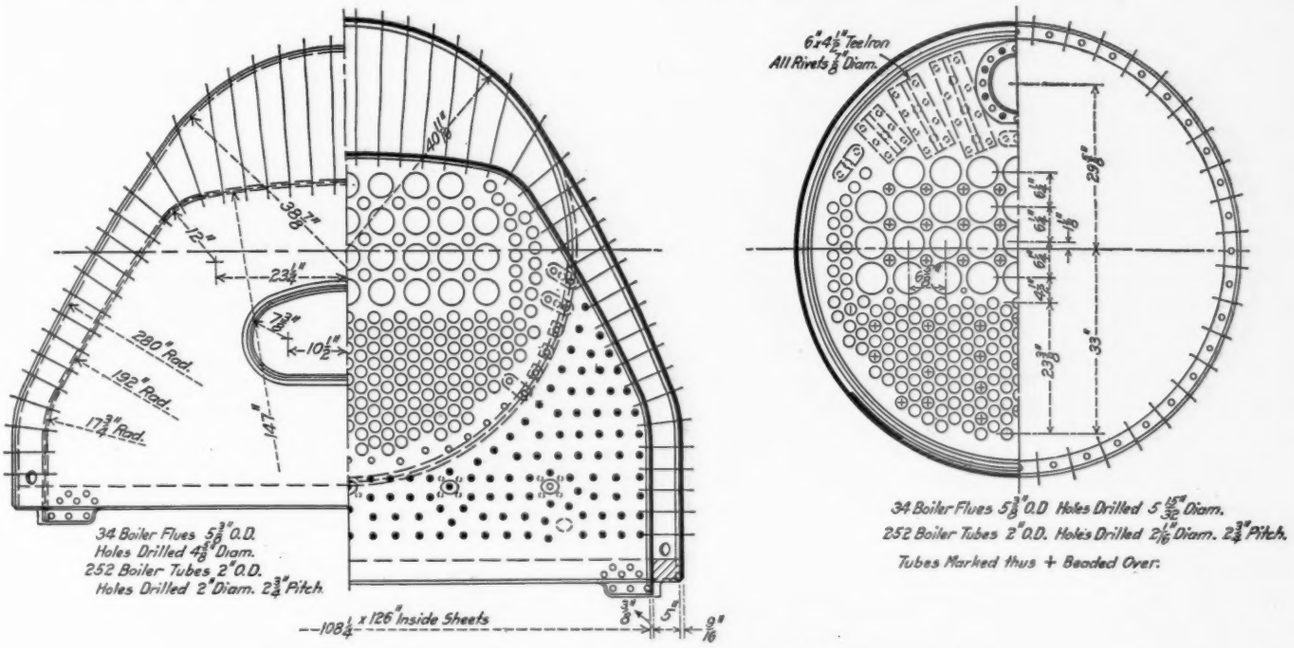
Boiler.

Style	Straight top Wooten.
Working pressure	200 lbs.
Outside diameter of first ring	78 in.
Firebox, length and width	126 x 108¼ in.
Firebox plates, thickness	⅜ & ½ in.
Firebox, water space	F., 6 in.; S. & B., 5 in.
Tubes, number and outside diameter	252—2 in.
Tubes, thickness	No. 11, B. W. G.
Flues, number and diameter	34—5¾ in.
Flues, thickness	No. 9, B. W. G.
Tubes, length	20 ft.
Heating surface, tubes	3,579 sq. ft.
Heating surface, firebox	239 sq. ft.
Heating surface, total	3,818 sq. ft.
Superheater heating surface	821 sq. ft.
Grate area	94.8 sq. ft.
Smokestack, diameter	16 in.
Smokestack, height above rail	15 ft. 3 in.

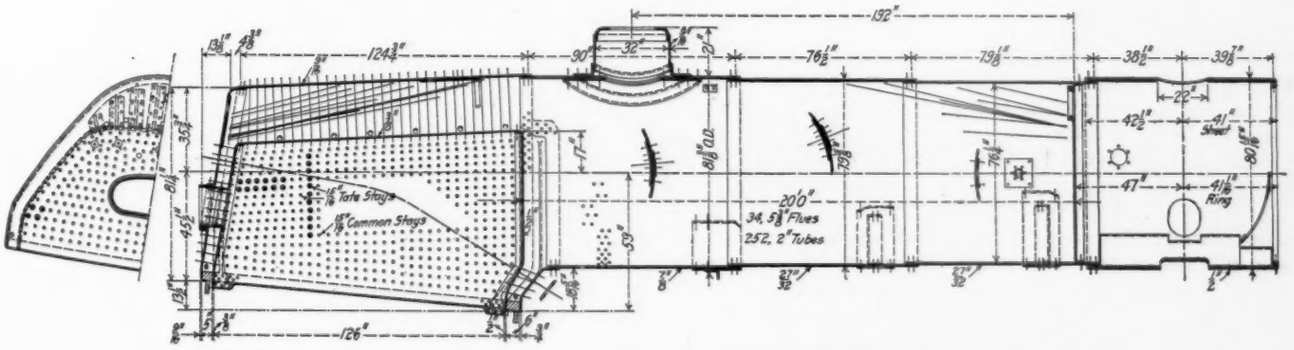
Tender.

Tank	Water bottom
Frame	Steel, 15 in. and 10 in. channels
Wheels, diameter	36 in.
Journals, diameter and length	6 x 11 in.
Water capacity	8,000 gals.
Coal capacity	14 tons

*Equivalent heating surface equals 3,818 sq. ft. + (1.5 × 821 sq. ft.) = 5,050 sq. ft.


6"x4½" Tee Iron
All Rivets ⅞" Diam.
34 Boiler Flues 5⅜" O.D.
Holes Drilled 4⅛" Diam.
252 Boiler Tubes 2" O.D.
Holes Drilled 2" Diam. 2¾" Pitch
108¼" x 126" Inside Sheets
34 Boiler Flues 5⅜" O.D. Holes Drilled 5 15/32" Diam.
252 Boiler Tubes 2" O.D. Holes Drilled 2 1/16" Diam. 2¾" Pitch.
Tubes Marked thus + Beaded Over.

Sections of the Wootten Firebox on the Lackawanna 4-6-2 Type Locomotives.



Large Boiler and Firebox Arranged to Burn Anthracite Coal; Lackawanna 4-6-2 Type Locomotives.

STEPLESS TROLLEY CAR.—The Brooklyn Rapid Transit Company, Brooklyn, N. Y., is trying on its surface street railways a "stepless car." All passengers board the car at a center side entrance. This opening is 6 ft. 6 in. wide. It provides an entrance aisle 33 in. wide and two aisles for exit 21 in. wide on either side. The center platform, which passengers reach upon entering, is only 14 in. above the top of the running rail. The conductor is seated at the entrance in charge of a fare-recording device. After paying fare the passenger may step into the car toward either end. Both passengers and conductor signal the motorman to stop the car by pressing an electric push button. The signal for starting consists of small electric lamps placed in front of the motorman which are lighted only by the closing of all the doors. The conductor can stop the car quickly by operating a special valve within his reach. A similar car is also used in New York City.

RAILWAY GENERAL FOREMEN'S ASSOCIATION

W. L. Park, Vice-President of the Illinois Central, Speaks Frankly on the Labor Problem. Splendid Papers, Well Discussed.

The eighth annual convention of the International Railway General Foremen's Association was held at the Hotel Sherman, Chicago, July 23-26. F. C. Pickard, master mechanic of the Pere Marquette at Saginaw, Mich., presided. The convention was opened with a prayer by Rev. Annesley Thomas Young, after which an address of welcome was made by Maclay Hoyne, first assistant corporation counsel of Chicago. W. W. Scott, shop superintendent of the Pere Marquette at Saginaw, Mich., responded to Mr. Hoyne. The secretary-treasurer's report showed a membership of 135 and a balance in the treasury of $835.06.

PRESIDENT PICKARD'S ADDRESS.

After commenting on the splendid work done by the committees during the year and on the growing importance of the work of the association, President Pickard said in part:

A suggestion was made at the last convention that the executive committee confer with the executive committee of the Master Mechanics' Association, with regard to having certain matters referred to this association that the larger one is unable to handle because of the pressure of other more important matters. President Bentley of the Master Mechanics' Association has taken a keen interest in this association, and was quick to grasp the suggestion, and made considerable mention of it in his address at the June convention.

The introduction of superheat on locomotives has given a good account of itself in both freight and passenger service. Careful study should be made by the general foremen as to maintenance of engines so equipped, especially in the first year of their service. Economies in shop practice mean a reduction of cost and increased output. They involve the proper location of machine tools and also of the buildings, so that unnecessary handling of material will not be necessary; a great deal of time is lost in this way. I would suggest that visits be made to other shops by yourself and your subordinates to see what the other fellow is doing.

Staff meetings should be held weekly in the office of the general foreman, shop superintendent or master mechanic, to talk over the work of the past week and to plan the work for the coming week. You may have figured on seven engines and only turned out six. The reason for the failure should be located. First ask the gang foreman who has charge of the pit where the trouble occurred and as to the cause—whether it was on account of the boiler work, blacksmith work, or shortage of material. In this way you will be able to place the responsibility and trace it direct to the department where the failure occurred. It may be that the force is not equally divided, that it may need building up, or it may be a lack of machine production. When you take a matter of this kind up always be sure to determine the real cause of the trouble.

Specialization of mechanics and shop laborers is an important factor and worthy of a great deal of consideration. Special grouping of machine tools should be studied to avoid unnecessary transferring and handling of parts through the shop. Several hundred experts may gather in convention and tell of a great number of ways of doing a certain piece of work. You can figure that 95 per cent. of these are wrong. We, as an association, must decide which is the best.

ADDRESS BY W. L. PARK.

W. L. Park, vice-president and general manager of the Illinois Central, made the following address at the Wednesday afternoon session:

In my opinion, the paramount problem confronting the mechanical foremen of our American railways today is the effect of socialism on the working forces.

In recent years we have lost much of the *esprit de corps* which formerly characterized our shop labor. There is not to be found anywhere, as obtained a few years back, that firm control of the employees, so essential to the proper conduct of large industrial undertakings. While there has been, perhaps, improvement in contract shops in general efficiency, it can be attributed more to new machinery and methods than to increased efficiency of labor. The inability of the railway shops to increase their efficiency in the same ratio was brought out quite prominently in the recent discussion of Harrington Emerson's scientific management, used by Mr. Brandeis to defeat, for his clients, the railways in their request for increased rates in the hearing before the Interstate Commerce Commission.

Of course the shop foremen and railway men generally knew the impracticability of the Emerson-Brandeis theories. At the same time it appealed to the people who were unable to differentiate between the factory that could close down indefinitely if threatened with labor troubles, with hardly a ripple on our industrial activities, and the railway, which is compelled by its charter to operate daily. The public was not well enough informed to distinguish between theory and practice, consequently the sentiment was molded against the railways, and their case was lost. When the government attempted to make scientific management effective in its own shops it was met with difficulties which were not insurmountable, but which seemingly appalled them, and they laid down ignominiously.

We all know that railway shops can be run more economically if certain facilities are provided and the control thereof turned back to the managers. Railways, from dire necessity, practice economy and have done so for years. You probably all remember the story of the examination of the fireman for promotion to an engineer on a railway making strenuous efforts to economize, among other supplies, in the use of oil. The fireman was asked what action he would take as an engineer if he was suddenly confronted with an approaching headlight on the same track. He thought the matter over seriously, and, brightening up as the answer came to him, said: "I would grab the oil can and the tallow pot and jump off."

Another story of at least a quarter of a century of antiquity is that of the manager who found along the track in the weeds a railway spike, rusty and bent. Carrying it to the section foreman, he proceeded to give him a lecture on economy. The foreman took the spike, looked it over carefully, and said: "I have had a man looking for that spike for two days. Where in hell did you find it?"

As you gentlemen know, the greatest difficulty in operating a railway shop as you would like to operate it is the present attitude of the labor element. Organized ostensibly to benefit their members, the unions have recently become subservant to the service of certain individuals of strong socialistic tendency, who, to not only insure their salaries, but certain perquisites and emoluments, constantly instill insubordination, dissension and dissatisfaction into the rank and file, which in turn breeds indifference, bickering and strife.

Our railways, because of their magnitude, are particularly vulnerable. One foreman may have absolute control of his particular shop, treat his men fairly, and obtain a reasonable amount of work. He is, nevertheless, affected by shop methods and adverse conditions existing in some remote locality, which upset

his best calculations and cause his men to be overcome with imaginary grievances. It behooves us all to make a most careful survey of the situation and get together to apply the remedy.

There has been too much managerial caution in this country for the good of the railways. We have temporized too long with socialism, syndicalism and other pernicious isms. When organized labor attempts to dictate who shall be employed, regardless of capability, and who shall be foreman, regardless of all qualifications other than seniority or unionism, it is digging a pitfall into which it or its employers must eventually disappear. When the organizations again realize that they are to man the railways, and the managers must be left to manage them, they can begin to really better their condition. No business can prosper saturated with disloyalty and steeped in incompetency, bred by labor restricting fanatics and socialistic agitators.

The railways can perhaps stand more of it than ordinary business, but there comes a breaking point, and it is with a breath of relief that many a foreman has stretched forth his arms and said, "Thank God, I am boss again," as the strike line filed out of the gate. He had been ignored, mistreated and humiliated. He was not turning out the work he was capable of doing. He saw on every hand waste of time and material—an unnecessary waste, an ungodly and unjustifiable waste of his employer's property, powerless through the tyranny of the organization to prevent it, and when the thing broke he felt the shackles fall from his arms. He knew trouble was ahead, but he welcomed it as a relief from an intolerant condition, repugnant to every right-thinking and honorable man.

What is the trouble? Is it with the bosses or with the rank and file, or with both? Railways which treat their men liberally with pensions for old age, modern hospital departments, good working conditions and the highest wages are frequently the ones to suffer first.

Let us attempt to analyze the problem. We are all cast in the same mold. In this country we are assured under the constitution equality of birth. Our best statesmen, business men and industrial captains have been self-made men. The same opportunities exist today as have heretofore existed. There is no boy in this wide land endowed with health and average intelligence who cannot make a place for himself far above the working classes, if he chooses. He must be loyal, industrious and studious. All these attributes are seemingly treated with contempt by the modern shop labor organizations. Instead of examples to emulate and advice to rise in his chosen profession, the young apprentice is instilled with disloyalty and insubordination, constantly told to do as little work as possible, to deceive his foreman, and that his employers are grasping capitalists seeking his undoing. He is told that the shop foreman wears a brass collar, that he obtained his preferment through favoritism, and that he is a nonentity anyhow—the shop committee dictate to him where he should head in. He listens to socialistic talks, and is advised to keep away from the night schools, so that his time is occupied in poolrooms and other questionable amusements.

He must be indeed strong if he can fight shy of all these harmful and pernicious influences and rise above his fellow-shopmen. If he does, he has the mettle and stuff in him of which men are made. A good father or a good mother leads him onto the goal, past the temptations of the shiftless and envious, aided by a foreman who has had the same experiences and who is quick to note the material available, until finally he emerges into his estate, one of a thousand who successfully pass the insidious temptations surrounding him.

I can remember when it was not considered treason to his fellow-workmen to be loyal to his employer. I know of a time when an employee on the railway could do something for which he was not paid without fear of ridicule or a lodge fine. It is entirely within my recollection when a foreman was looked up to for advice, and his word was the law of the shop. He did not require a walking delegate or a shop committee to dictate to him how far he could go, and where he should stop. Only a few years ago employees who asked for the dismissal of a foreman invited disaster to themselves.

Are the foremen less competent today? I think not. They have been made in a hardier mold. They may, from necessity, be more diplomatic. They may gum-shoe through the shops to avoid trouble. They must be more ingenious, more tactful, and more resourceful, to meet the present conditions. Their responsibilities are greater, as are all of the responsibilities of the railway man of today, as compared with a few years ago.

How long can present conditions obtain? Can a master mechanic or foreman fear his employees and their power and influence with those in authority and render efficient service? Does he not lose in self-respect when he lets some shiftless agitator tell him who shall do certain work and who shall not; when he is compelled to use as a gang boss, by reason of seniority, a man he knows to be incompetent and disloyal; when he is compelled to not see spoiled work, misused tools or time-killers? If his energy, ability and desire for increased responsibility is to be circumscribed by carelesssness, disloyalty and ingratitude, is he not apt to degenerate and lose heart?

It is the crime of our industrial life that such conditions obtain, and they do obtain to a greater or less extent in every railway shop in this country, and they are not getting better—on the contrary, they are getting worse. The men are dissatisfied, they are not prosperous, they are full of unrest. They are assessed unmercifully to remedy some far-fetched grievance of which perhaps they have no knowledge. The wives and children suffer, and they are taught by the professional fixer of their wrongs to strike, as the serpent, at the hand that feeds them. The effect of deception, violence and brutality is always a boomerang, but it is deplored that the innocent must suffer while the guilty are, for a time at least, seemingly prosperous.

Not all of the organizations are conducted in this way. Those that are not are making real progress. They have wise leaders who are conservative. They advise and compel their members to keep contracts. They go to the very extreme before breaking with their employers, and seldom does such an event occur; consequently, they are respected. They do not attempt to interfere with the management of the property, therefore they do not become *persona non grata* with their superiors.

The metal crafts must throw off this yoke of ignorant and corrupt leadership. They are intelligent men. They certainly can be deceived only a part of the time—not all of the time. Let them make an impartial and searching investigation of their affairs and compare them with other organizations working for the same people. Select men who are trustworthy and intelligent to conduct their affairs on the same lines. Make an effort to uplift their organization to the plane of intelligent, reasonable and conservative employees. Concede to the managers an interest in their affairs, instead of imaginary hostility. Give the foreman credit for knowing his business. He should be unrestricted by lodge affiliation—he cannot serve two masters. Remember that there was only one perfect man, and he was crucified two thousand years ago. Give and take. Let the indolent, improvident and unskilled take their proper places in the scale of humanity. Give every man and boy a helping hand, and a good wish that he may become foreman, master mechanic, superintendent of machinery or manager, and help him get there.

The employees should take pride in the railway and resent any interference with its rights, and contend always that it shall have a square deal and living rates. It will then be in a position to give a square deal and good wages. We should all work zealously to bring about such a condition of affairs. We all know what is essential for the good of the employees, the railway and ourselves. This cannot be accomplished with the mailed fist; it must be done by placing before the men the true facts, obtaining their confidence by fair, impartial treatment, giving them less cause for grievance committees. The shop foreman should be a walking delegate for the men under him.

Labor must be taught how to throw off the yoke of autocratic

and arbitrary leadership. The professional labor leader should be relegated to the scrap heap, and only the intelligent, conservative and diplomatic members of the organizations elected to such responsible positions. The tenure of office should be dependent upon the maintenance of harmonious relations with the employer. Those who are contentious and arrogant should be considered unsafe; those who misrepresent facts, deceive their membership and practice dishonorable methods should be gotten rid of absolutely.

The organizations should confine themselves to controllable units. If there are momentous questions involving the possible loss of position and the savings of a lifetime, the membership—and not the irresponsible officers—should decide the matter.

There should be calm debate and most careful consideration of every phase of the controversy. The voting power should be secret and sacred, free from intimidation or official influence. There should be a free expression of ideas and brotherly consideration for those of different views. The minority is quite frequently in the right.

When a contract or agreement is made it should be sacred; no flimsy pretext gotten up to serve a temporary purpose should be permitted to break it. The commercial world is founded upon credit. He who breaks his word is ostracized. It must be so between employee and employers.

The general foremen have a greater power to bring about right conditions than any other influence. They are generally from the ranks. They are in constant touch with the managers, and close to the rank and file. Their knowledge of the right and the wrong is born of years of experience and carries conviction. The time is opportune to commence this work. The men are sick of the mistakes of their leaders; they are tired of unsuccessful strife, and ready to do business on business principles.

The Cleveland Federation of Labor recently adopted resolutions to bring about more friendly relations with employers. Labor will find no great difficulty in reaching common ground and harmonious relations everywhere, if they are disposed to apply the Golden Rule literally to their efforts.

MR. DE VOY'S ADDRESS.

James F. De Voy, assistant superintendent motive power of the Chicago, Milwaukee & St. Paul, addressed the association at the afternoon session of the first day. Among other things he spoke of the importance of such organizations as the General Foremen's Association in determining the proper methods of doing work and suggested that they were far more capable of doing such things than state and other commissions. He said that a great deal of trouble had been caused on his road during the past winter because of hot boxes on locomotives. All the mechanical officers were called together and the question of the proper method of finishing a driving box journal was discussed. Some maintained that it should be done one way, while others thought it should be done another way. It is up to the association to determine which is the right way of performing various shop operations. Mr. De Voy had heard different organizations criticised as to the amount of good they had done, and as to whether it paid the railways to send representatives to the meetings. It does pay! He said: "If you will return and tell your people the way that things should be done, if you will fairly instruct the men that have to do the work, you will not have any trouble with the labor organizations. You ought to be able to judge, if you are a general foreman, what time it takes to line up a set of shoes. wedges or guides or anything of that kind; you ought to know whether a man gets a fair wage; and if he gets a fair wage your province in the matter is to see that he delivers to your superiors value received for just what he gets and not to abuse him when he does it."

HOW FOREMEN CAN BEST PROMOTE EFFICIENCY.

W. G. Reyer, general foreman locomotive department, Nashville, Chattanooga & St. Louis, Nashville, Tenn., read a paper on the above subject, of which the following is an abstract:

A shop with only five pits should be handled by one foreman, who should have charge of both the machine and the erecting shops. In a shop of this size the gang bosses who have charge of the copper shop, paint shop, tank shop, air brake department, and toolroom should be expected to work. In a shop with 10 pits there should be a foreman of the machine shop and a foreman of the erecting shop and two gang bosses; also a foreman boiler maker, blacksmith foreman, air brake foreman, carpenter foreman, paint foreman, copper shop foreman and truck builder foreman. In this size shop foremen should not be expected to work, but to follow up the work and also the men closely. In a shop with 15 pits there should be a general foreman and an assistant, with demonstrators in the machine shop. Also one gang boss to every five pits in the erecting shop, and one gang boss for all pits to look after the steam pipes, dry pipes, cab work, pops, whistles, and hand railing; the other departments should have the same supervision as a 10-pit shop, except for the boiler shop, and the foreman of that shop should have an assistant. In a shop with 20 pits, or over, there should be a shop superintendent and a general foreman over the erecting shop, machine shop and other departments.

The general foreman or shop superintendent should show the men that his word and his way of doing things mark him as a man of firm character and good judgment, one who says what he means and means what he says. This kind of a man is bound to be respected. When you gain the confidence and respect of your men they will put forth their best efforts. An organization is not up to a good standard if the head of any department cannot be spared away for a reasonable length of time, and the department keep up its work the same as if he was present. Every position of any importance should have a man who at a moment's notice will be able to fill it, if it is vacated.

Men should be paid according to their individual merits Some men are naturally quick, both to grasp an idea and to do the work, and will push the work with energy. Others will work all day and accomplish very little. Some men can do only one class of work, others are all around mechanics. My plan is to advance a man as he progresses and broadens. I believe in paying the best established wages to the hustler and thinker. We have made it a practice to hire handy men, whose general appearance and manner of speech show they are capable of learning. I tell them what I will start them at and also that it is "up to you to make good, and get your wages raised." The workmen and the company both gain by the step rate of pay. The workman gains because he knows he has to accomplish something and pushes at every opportunity to advance his work. He begins to study out plans to shorten the operations and thinks ahead. He soon finds that if he exercises his mind a little he will accomplish more with less labor.

Plan of Organization.—[Mr. Reyer's intention in going so thoroughly into the details of the work at the Nashville shops was not because he considers it an ideal plan for other shops to follow in detail, but rather to show the extent to which the specialization of work may be carried with good results. The conditions at Nashville are peculiar and the details of the plan of organization are made to suit them, and would not be applicable to the same extent elsewhere. What he intended to force home was the importance of the general principle of highly specialized work which will give good results in any shop, although the details will have to be worked out to suit the local conditions.—Editor.] We have a general foreman and an assistant, four gang bosses, a machine shop foreman and an assistant, tool room foreman, boiler shop foreman and an assistant, two inspectors, and foremen of the following departments: Copper shop, blacksmith shop, engine painters, engine carpenters, truck builders, airbrake and air switch foremen In the engine house we have a foreman and an assistant, also a night foreman. It has been the practice of the road to ad-

vance its men and it gives good results, for they will strive to show their ability to hold more important positions.

A man in charge should be firm and positive, not too familiar with his men, and yet let them know that he is approachable at any time if the circumstances call for his time and attention. Let the men know that your time is taken up by company matters, and that only when the case cannot be handled by your assistant will you interfere. If it can be handled by a gang boss or a foreman, refer it to them for adjustment. If you want to have the best condition and smoothest running shop let everything come up through its proper channel, and if you find any man taking advantage of you discharge him.

We keep a record of each man's time and the engine or job on which he works, and can at a moment's notice estimate what any part of a locomotive is costing. We do all work by either shop or job numbers, and find that it works satisfactorily. All stock work is done by shop numbers. The department that originates the work stamps a ticket with a lot number, describing what is to be manufactured; all sub-requisitions bear the same number and are sent to any department that may be required to furnish material or labor to complete the work. Each department records the weight, kind of material, and hours it took to do the work. When the work is completed the tickets are placed on file and collected by messenger and delivered to the superintendent's office. We have regular reports made out by the traveling engineer containing advance information relative to repairs necessary to engines to be shopped at a future date. When engines come from branch lines we ask for a report and send out copies of it to the different foremen.

Our method of testing steam pipes, nozzles, nigger heads, steam chests, joints and front and back cylinder heads is to fill the boiler and apply hydraulic pressure at 110 lbs. This will show whether the work is properly done. We use 1/16-in. wire-woven asbestos under the nozzles with excellent results. This does away with spotting down these parts and saves labor.

After the locomotives are overhauled they are tried out by a special engineer, who also makes an inspection of the engine and reports in writing any defects he finds. When these are repaired it is sent out on the road, and the engineer runs it until he can report it O. K. for service. Whatever work he reports is handled by the erecting shop. It is then turned over to the roundhouse, after which all repairs are made at that place. In the roundhouse are two day inspectors and one night inspector. The day inspector's work is divided as follows: One man inspects the tank trucks, drawbars, wedges, spring rigging and has charge of the men who do this work. The other inspector looks after the inspection of rods, guides, crossheads, link motion, frames, and all braces, binders, shoes and wedges and reports any defects to the engine house foreman. We also have special men to look after and make repairs to the netting, front-end rigging and ash pans. Another special man examines all axles, crank pins, piston rods and side and main rods; besides this he has charge of re-turning all driving wheels, engine truck wheels, tank truck wheels, and coach wheels.

We try, as nearly as we can, to run our passenger and freight engines 100,000 miles. The switch engines we try to run from 40,000 to 60,000 miles. The superintendent's office gets reports from the traveling engineer as to the general condition of engines. Where the general foreman can get a report on any engine that is to be shopped and has a large enough force and machines for stock work, this information is of great service and should naturally shorten the time the engine is in the erecting shop. To illustrate: Suppose any engine needs a new firebox, cylinders, cab, driving boxes, shoes and wedges, tires, crank pins, rod brasses, or tank frames. If this information is in the general foreman's hands 30 days before the engine is sent to him he could advise the different departments that a certain engine would be shopped in 30 days and would require certain repairs, and to see that the parts required were ready for the engine.

The work in the erecting and the machine shop should be specialized. If this is done the output will be increased from 25 to 30 per cent. over the shop that does not specialize. Again, a part of the erecting shop should be reserved for repairing and assembling the work. In our shops we have twelve working pits and always try to reserve sufficient floor space and handle the work as follows:

Handling spring and brake rigging requires about 8 ft. x 15 ft. This work is done by one handy man and a helper. They inspect all parts and send such as need repairs first to the blacksmith shop. The smith work when finished is returned, laid off, and drilled and when the engine is ready these men apply the brake rigging. They also look after and keep up stock for shipment on the road.

Handling steam pipes, dry pipes and exhaust pipes requires about 8 ft. x 25 ft. This work is handled by three handy men and three helpers. They remove all pipes and the crane then transfers them to the part of the shop reserved for this work. Here they are inspected and ground. If any new pipes are required it is reported to the gang foreman, who orders them from the foundry, stating just when they are wanted.

Rocker arms, rocker boxes, tumbling shafts and boxes require about 6 ft. x 12 ft. This work is looked after by a handy man, who examines all parts and sends them to the different departments for repairs. After the parts are repaired, he gets them ready for application, but he does not apply any work. We use a brass bushing in our rocker boxes. This is cast in halves, sweat together, then turned and bored to fit the box and arm. We apply two set screws to hold it in position. This brass has a collar on the end to take up lost motion.

Steam chests, valves, valve rings, valve strips, and vale yokes require about 6 ft. x 8 ft. This work is looked after by one machinist and one apprentice. Together they face the valves, apply the steam chests and see that the necessary repair parts are kept in stock.

Pistons, crossheads, and cylinder rings require about 8 ft. x 15 ft. This is looked after by one machinist and one handy man. They examine all crosshead guides, piston heads, and piston rods for cracks. The work is sent to the machine shop with the working instructions. They also lay off key ways for new piston rods and fit the keys; if new piston heads are required they see that they are properly prepared. They also get all the cylinder rings and cut them.

Quadrant and reverse lever work requires about 4 ft. x 12 ft. It is handled by a machinist who removes, overhauls, and applies these parts.

The shoes and wedges are looked after by one machinist and one apprentice. They examine all shoes and wedges and fit up new ones, or true up the old ones when they are used over. They also square the engine and lay out the work. We have one machinist who files pedestal jaws and looks after the binder and binder bolts.

The cab fittings and pops require about 4 ft. x 6 ft. space. This work is handled by one machinist and one apprentice. They remove these parts and send them to the brass lathe to be overhauled; when the engine is ready they reapply them. They also see that gage cocks are in good condition, that the steam gage and connections are O. K., set the pops, and see that all steam leaks are stopped.

We have one machinist and one apprentice on lining guides. They examine the guides, and, if worn, send them to the guide grinder to be ground, and apply back cylinder heads or lay off new ones when required. They have no floor space reserved for this work.

We have handy men for drilling and cutting holes in boilers. Also two machinists and two apprentices to apply links, eccentrics, eccentric straps and set the valves. They examine all eccentrics and straps; if new eccentrics are required they re-

move the old ones and send the new ones (which they keep in stock) to the machine shop.

The link work is overhauled on the machine shop side, and requires about 6 ft. x 15 ft. It is done by one machinist and one apprentice. After the links are removed from the engine they are sent to the link bench, where a machinist examines them for cracks and overhauls them. We use brass bushings and have a special reamer to ream out holes after the bushings are applied. We grind all pins after they are case hardened. By this method we get an accurate fit.

Our rod work is handled on the machine shop side, and requires about 12 ft. x 15 ft. This work is handled by two machinists and one apprentice and three colored helpers. They do up all the rod work.

The driving box work is handled on the machine shop side and requires about 6 ft. x 8 ft. It is looked after by one machinist who examines and applies all brasses, gets the lateral for the boxes, and applies all brasses for stock boxes.

In the machine shop are special machines to do the following work: One lathe handles all piston rods. The operator examines old rods for cracks. One lathe takes care of all piston and valve stem glands, makes all new work that is required, and grinds all glands. This lathe also takes care of spark caps. Another man at a lathe turns all valve stem and piston rod packing and bores out to suit the engines. He keeps a book record of the size of all the valve stems and piston rods, so that the proper packing can be sent to any point if the engine number is given. This takes about one-half of his time and he is assigned other work to fill out the time. One lathe takes care of the air pump work and pops. We have two lathes to handle crosshead pins, knuckle joint pins, valve yokes, and solid rod bushings. Two lathes do all the link work. Three lathes are used for brass parts. We manufacture all injector repair parts and repair parts for pops, all gage cocks, cylinder cocks, checks and throttles. One boring mill, and sometimes two are used on driving boxes and rocker boxes. One planer is used on new driving boxes, and at times the operator has a chance to do other work. There is one planer for valves and valve strips; one shaper for rods and rod brasses; one draw-cut shaper fits all driving brasses and does other work, as well; guide grinders are provided for grinding all guides, and a miller for milling all shoes, wedges, and crosshead gibs.

We have a delivery gang of colored helpers. They handle material from the erecting shop to any department and return it when it is ready. We also have a special repair gang that looks after all machinery and the manufacture of all shop appliances. Our special men have the necessary tools issued to them by the company, a careful check being kept on them so that they cannot be stolen. We issue to each man ten checks. This allows him to draw this number of tools from the toolroom. All checks are numbered and each man's name is registered in a book with the number of his check. All tools must be in the toolroom at the end of each day's work. If necessary to keep them out, they must have the approval of the gang boss. If tools are not returned in a reasonable time, the toolroom foreman sends the check with the name of the tool to the general foreman.

Before we made specialists of our men we had a messenger and telephone service, but the present plan is to equip each man with the tools and wrenches suitable for the job assigned to him, and this cuts down the number of trips to the toolroom. If he needs anything from the toolroom, he sends a helper for it.

Discussion.—In studying Mr. Reyer's paper it must be kept in mind that the Nashville shops are non-union, that colored helpers are available, that the shop is not exceptionally large, that the men are paid on a day-rate basis, and last, but not least, that it is very much overcrowded and that it would be desirable to assign much more space to the various classes of work. The purpose of the paper was not to recommend the practices as ideal for conditions as generally met with, but to show the value of highly specialized work. A number of questions were asked and some criticisms were made, which would not have occurred but for a misunderstanding on the part of the members as to the purpose of the paper. These will be passed over in reporting the discussion.

C. L. Dickert (Cen. of Ga.) suggested that the amount of supervision for a shop with a given number of pits would depend on the output per pit per month. In other words two shops of 10 pits each might differ so greatly as to output per month that one would require very much more supervision than another. He also said: "The question of handy men is one that depends on local conditions. We are not allowed handy men except on drill press work and bolt cutters. I think Mr. Reyer has too many gang foremen for the number of pits. We have 22 working pits and only two gang foremen. The assistant general foreman has jurisdiction over the boiler shop, machine shop, blacksmith shop and copper shop, and we get along very nicely."

L. A. North (Ill. Cen.) did not believe in making a working gang foreman out of any gang foreman. If he takes care of his men he has all he can do without working, although he should not be afraid to help the job along. If a man supervises his men and looks after the material, he has about all he can do. Mr. Reyer replied that in the very small shop he thought the gang foremen should work part of the time.

W. Smith (C. & N. W.):—Mr. Reyer does not speak of the method of stripping engines. One of the most important things that a general foreman has to contend with is the arranging of the material that is stripped from the engines in order that it will not be lost or overlooked. It puts the shop to great expense if things are not where they can be found when needed. His method of tool checks is good, but I think there are other methods that are as satisfactory. A rotary rack in the tool room with the different checks and numbers kept on it is a good scheme, because there are times when the men will take the checks home with them and forget to bring them back. With the rotary rack in the tool room, the man in charge can look after the checks. It works very successfully in some shops. The method of specializing work, and having special tools for the special gangs, is good, and all shops should follow this method. The men should be provided with suitable shelves or drawers in which to keep the special tools. The general foreman should always be willing to have special tools made, for they will promote efficiency to a great extent in any shop.

William Hall (C. & N. W.):—The gang boss has enough to do without working himself. I agree with Mr. Reyer that there should be ample supervision. Ample supervision, but not too much of it. I also agree with him that an organization is not up to the standard when the head man cannot be spared to attend a convention. It shows poor organization when the head of it, or the man next to it, cannot be spared for a reasonable length of time.

W. Smith:—How does Mr. Reyer manage to take care of delinquent gangs? One gang is apt to get behind another, and thus effect the output of the shop.

W. Reyer:—Replying to the criticism about the number of gang bosses, we use more than might be justifiable at other places because of the special labor conditions at Nashville. We do not have a regular shop schedule for turning out engines, but accomplish the same purpose by going over matters thoroughly at our weekly meetings. We have not enough floor space. Our shop should be twice as large as it is to handle the work as well as I should like to. At one time we were cramped and crowded and got far behind with our output; we closed three of the working pits and used the floor space to assemble the work with marked improvement. We have no store house. Mr. Smith spoke about making provision for the

gangs that got behind with their work. We have a gang that looks after dead engines in the enginehouse. This gang I can move or transfer to any department which needs help.

President Pickard:—It has been brought out very plainly that there are a lot of conditions in the different localities that will enable one shop to do the work more economically than another shop in another portion of the country. Different members of the mechanical department have been called before commissions that do not know anything about shop practices. They act as judges for us, and the comparisons are not fair, from the fact that the classification of one road's engines may be different from another road.

It was suggested that the Canadian Pacific had made considerable progress in getting a fair basis of comparison of one shop with another, and the executive committee was asked to see if it could have some one from that road at the convention next year to tell about it.

ADVANCE INFORMATION ABOUT ENGINES TO BE SHOPPED.

C. L. Dickert, assistant master mechanic, Central of Georgia, Macon, Ga., read a paper on the above subject, of which the following is an abstract:

It is absolutely necessary that the erecting, machine, and boiler shop foremen should know as far in advance as possible when a certain class engine is to be shopped, in order to make the repairs promptly. The foremen should also know whether it is in need of new cylinders, frames, tires, firebox, flues, or any heavy repairs that are not generally given an engine shopped for general repairs. It will not only facilitate the handling of such repairs, but will enable them to carry a minimum of material in stock.

We have a method that enables me to know the condition of all power at all times. A form is worked up each month, showing the condition of each engine; when it is expected to be shopped; the class of repairs it is to receive; the condition and life of the firebox, boiler, and flues; the condition of frames, cylinders, machinery, cistern, and tank trucks; tire wear and thickness, and the general condition of the engine —whether good, fair, or bad. In going over this form each month with the master mechanic, we select the engines that are to be shopped within thirty days. These are submitted to the superintendent of motive power for approval. This is a great help to the shop foremen in making preparations to handle engines when they are shopped. If the foreman has no knowledge that a certain class engine is to be shopped until it is run in the shop on the stripping pit, how is he to know, until an inspection is made, whether or not he will have to arrange for new cylinders, frames, or any part that requires renewing. After this inspection (which takes time) he has to hustle to get in his order to the different departments; then he may find there are no cylinders on hand. If he had known thirty days before that they would be needed, he would have looked over his stock and made sure that he either had the material on hand or that it had been ordered. In going over this form each month, I know exactly what engines will need new tires when shopped; I look over the stock and see what I have on hand and order new ones accordingly.

Discussion:—A lengthy discussion followed the reading of this report, the more important points brought out being as follows:

G. H. Logan (C. & N. W.):—We make out a shop list from the condition of power report, showing all engines that will need shopping within 90 days.

L. A. North (Ill. Cen.):—I think the method mentioned in the first paragraph is good for small shops. With a 25 pit shop we find it necessary to carry plenty of stock on hand, such as cylinders, tires and other material which is likely to be needed. Once a month I make it a point to talk over with the general foreman of the engine house what engines are likely to be shopped, and as a general rule there are from seven to ten dead engines, of which we have had advance notice, giving us ample time to get the material that may be required for them.

W. F. Fowler (Nor. Pac.):—We make out a report about 30 days before an engine goes to the shop; it shows everything that is necessary to be overhauled.

T. J. Mullen (L. E. & W.):—We have what we call a power meeting every few months. A report is drawn up which shows when each engine on each division should be shopped, and the class of repairs that each engine should receive.

H. G. Dimmitt (C. M. & St. P.):—We have a system a great deal like the ones that have been outlined. The monthly form shows the condition of all parts of the engine; from that we can tell about when each engine will need to be shopped and what material will be necessary. But one of the disadvantages of our report is the inaccuracy on the part of the enginehouse foremen who supply the information. For instance, they may think that certain cylinders will need renewing, when the shop inspection will show that such is not the case; we can not work up material on these reports on that account. We have orders to get together with the general enginehouse foremen each month and all conditions of the engines are discussed, and the master mechanic decides which ones are to go to the shop; it is up to the general foreman to line up the material for them.

Question:—What in your opinion would be an ideal way of handling the advance report?

Answer:—I think it should be handled from the master mechanic's office, all of the general enginehouse foremen to report to him. He should go over their reports carefully and also add any information that he may receive from his assistants, and possibly consult with the general foreman as to what he could handle in the shop. In that way he can tell how many engines it will be possible to put through the shop, and what classes of repairs can be handled to the best advantage.

G. H. Logan:—We have what we call an X and O sheet. It is a large sheet and all parts of the locomotive are listed on it. They are filled in by the division master mechanics when engines are sent to headquarters for repairs, or by the enginehouse foreman when they are sent to division headquarters. In listing the engines on the power report the master mechanic states when each engine will need repairs and then furnishes the X and O sheet. Any part that needs new material is marked X; where repairs solely are needed it is marked O. In this way we get a good idea of what work will have to be done in the shop. The X and O sheet includes all parts of the boiler, engine and tender.

W. Smith:—If the advance information is not correct a report of this kind is of no value. In some places the way the advance information is prepared is a sort of a joke; it is done by the enginehouse clerk or the master mechanic's clerk, or some one who has not a proper understanding of the condition of the power.

L. A. North:—The X and O sheet appeals to me, if for no other reason than that it checks the work and we can see where the money is spent. If the work done was checked against the X and O sheet which was sent in and the man who made it out was notified of the differences, I think there would be more correct information sent in from the outside points.

C. B. Hitch (C. & O.):—I think the card system is a very good one. We have such a system, and no report is made on an engine unless something unusual appears. If an engine in the enginehouse develops a cracked cylinder, and the enginehouse foreman thinks it will need a new one, it is reported to the general foreman's office and noted on the proper card for reference. The boilermaker foreman tests the boiler and if he thinks it needs flue sheets or sides, he immediately reports it. If the engine leaves the division and goes to another division, the card is mailed to the master mechanic of the other division. When

an engine is shopped, we immediately know whether there are to be any unusual repairs.

G. H. Logan:—On our road the advance information as to the condition of the engines is furnished by the road foreman of engines. It is one of his duties to ride all engines, and when an engine is found needing repairs to immediately make a report to the master mechanic of the nature of such repairs. On the North Western we get more of our information from the road foremen of engines than from any other source.

R. B. Van Wormer (Atlantic Coast Line):—The Waycross, Ga., shop makes all the heavy repairs to locomotives over several divisions and outlying points. The method used of securing advance information is the result of extensive experiments. When an engine is still in service, and immediately after it is authorized to be shopped for general repairs, a report giving the details of all necessary repairs is received from the master mechanic in charge of the division on which the engine operates. This includes a similar statement from the enginehouse or general foreman directly in charge of the engine, and frequently one from the engineer. This report when received at the general repair shop is used as the basis for another report or bulletin which may also include a notice of the standardization of any part, an examination of a device which has been applied for test purposes, etc. Copies are distributed to all foremen, who thus know the nature of the repairs required before the engine is received and can prepare parts to replace those removed. The advantages are greater than was anticipated. In addition to facilitating rapid repairs it familiarizes all concerned with the individual characteristics of each engine, the service resulting from the previous repairs which were made, and it also has a tendency to make more thorough inspections at outlying points, both before and after shopping the engine. The outlying points feel that the general repairs to be given the engine will be based more or less on their inspection and upon the return of the repaired locomotive will examine and criticise it accordingly. The back shop in turn may find some defect which was not discovered and reported, and at the same time it has the advantage of knowing of defects of invisible or inaccessible parts, such as leaky dry pipes, cracked mud rings, etc., without having to test for them. It also realizes its workmanship is subjected to close inspection by the outlying points. Frequently these reports show parts which were placed in good conditions shortly before the engine was shopped, and therefore need no attention. As the reports are kept on file it also enables the different departments to follow their work and see its condition when the engine is next shopped.

C. L. Dickert:—We have a foreman's meeting once a week when we line up the material, consider the engines to be shopped and look over the stock and see that we have enough material on hand. If not, we order it. The boiler shop foremen keeps a personal record of all fireboxes and boilers, and keeps in touch with their condition on all engines on the division. We have an X and O sheet that is furnished by the division master mechanic 30 days in advance of the engine. In reply to a question as to the accuracy of the advance information, Mr. Dickert said: "There are a few cases of work reported that it is not really necessary to do, and in other cases you will find work that is not reported."

G. H. Logan:—I move that it be the unanimous recommendation of this convention that advance information of 30 or 60 days is an absolute necessity for the making of proper repairs to engines on arrival in shops. The motion was carried.

SHOP SUPERVISION.

A paper on this subject was presented by W. W. Scott, shop superintendent, Pere Marquette, Saginaw, Mich., of which the following is an abstract:

It is safe to maintain that results gained in shops where the output is up to the maximum must be accomplished through perfect organization of the forces and frequent interchange of information bearing upon subjects that will best serve the purpose of enlightening each unit of the organization as to how the work is progressing. The engines to be shopped should be listed thirty or sixty days in advance of shopping. The necessary material can be arranged for, thereby making rush requisitions on the store department unnecessary. It keeps the department foreman keyed up to the highest point, so that his department will not have to explain a delay. It also gives the store department sufficient time to order and receive material. As soon as the engines arrive over the shop pit they should be stripped and all parts cleaned and taken promptly to the department where they are to be repaired. We consider under our conditions that 50 per cent. of the shop engines should be stripped with all wheels out, and 50 per cent. should be wheeled with the material being applied. By maintaining this ratio the machine side, boiler shop, blacksmith shop, and other shops will have the work evenly balanced.

All work should be specialized. But in order that the mechanics may be kept interested in the work and that they be not allowed to get into a rut, I advocate a change of workmen from one job to another every six months. In this way you will soon have a shop full of high-grade men, who can be used in any emergency.

It is a wise plan to allow your foreman to visit different shops with a view of noting how the other fellow is doing the work. I care not how small the shop may be, you will always find something which makes your visit worth while. It is also a good plan for the general foreman to put the work directly up to department foremen and not try to carry the full burden on his own shoulders. Make each foreman personally responsible for the efficiency of his department.

The general foreman must insist on absolute loyalty from his subordinates if he expects to maintain his organization, and he must be loyal and fair. The general foreman who allows a feeling of distrust of his judgment, or who wilfully misrepresents facts in order to increase his shop output will soon find that it may work once, "but never again."

Local conditions greatly determine the possibilities of shop efficiency. Your shop output may be at the mercy of a storekeeper who is not of a progressive and agreeable nature, and who takes particular delight in withholding information relative to material that you ought to know about. It stifles the ambition of any general foreman to be misled on a material proposition, and leads to a rapid decline of efficiency in shop management.

Labor conditions also have a direct influence for good or evil results. The lack of intelligent interpretation of work agreements with the attendant petty annoyances and discord engendered by reason of misguided leadership is known to have caused a falling off in shop output of fully 10 per cent.

It has always been a sound doctrine that when two broad-minded persons cannot fully agree on a declaration of principles, a fair and full discussion will have a tendency to eradicate any and all fractional issues, and establish a middle ground broad enough for both to stand upon without crowding. The reverse condition exists when one or the other is narrow. The general foreman must be broad enough at least to point out and carry the issue with his superior officer or with those who may be under his supervision. The broadening process can be accomplished by many methods, but the most successful, in my opinion, is through the process of study. Be a student of human nature and apply the knowledge gleaned from that source, with the information offered you in our mechanical publications, and you will be surprised to know what a high degree of efficiency you will attain in shop supervision.

Discussion:—A lengthy discussion followed the reading of Mr. Scott's paper. A number of members outlined the form of organization at the shops with which they were connected, giving some idea of their size and capacity. Reference was made in

one case to a shop demonstrator and that part of the discussion which is reproduced relates largely to the possibilities of such demonstrators.

L. A. North (Ill. Cen.):—We have recently installed machine shop demonstrators and it is a paying proposition. I am only sorry we did not go into it sooner. The foreman found that his time was so taken up with other matters that he had little time to look after details and facilities for increasing the output, and this has been turned over to the shop demonstrators.

T. J. Mullen (L. E. & W.):—I believe, as Mr. North says, that a demonstrator is a paying proposition. It takes the detail off of the other foremen and the demonstrator can instruct the men as to just how the work is to be done.

C. L. Dickert (Cen. of Ga.):—I do not agree with Mr. Scott on changing the men about every six months. If a man is not familiar with the class of work that he is put on it takes him from four to six months to get thoroughly on to it, and why change him after he gets accustomed to it?

R. B. Van Wormer (A. C. L.):—Our theory is, as far as possible, to cover each job by a man who can be responsible at all times for each operation. In case anything occurs that is not as we should like it, we know just where to look for the responsible party.

E. F. Fay (Ill. Cen.):—I find, in getting more closely in touch with the problem of shop supervision throughout the country, that it is not the general practice, as I thought it to be, to manufacture the various items of locomotive equipment used at the smaller outlying points at the general shop. Some roads make this a practice. It seems to me that it would be economy to manufacture the various items at the one central point. From past experience it seems to me that a shop demonstrator nowadays is almost a necessity, not only to relieve the burden that is imposed upon the machine shop foreman, but also to obtain from each individual a maximum output for a maximum effort. It requires a diplomat to be a good shop demonstrator—a man who can approach another man from any angle and get him to put forth his best efforts. I believe that the shop demonstrator has come to stay in the larger shops. I believe in supervision—lots of supervision. Of course, it can be carried to extremes the same as anything else, but ordinarily there is a tendency toward too little supervision.

J. S. Sheafe (Ill. Cen.):—Referring to Mr. Scott's suggestion as to a change of work every six months. It is impossible to get the best efficiency out of any organization unless you have the interest of the men. If they are given a chance to work on the various jobs in the shop they will appreciate it and will be stimulated to greater efforts. Referring to the tool room—at Burnside, we have our tool steel kept in the storehouse, a long distance from the tool room; a half hour is consumed by the machinists in getting the stock and returning the unused portion. I believe that a supply of tool steel should be kept in the tool room and under the direct supervision of the foreman. I have also noticed many good tools ruined by improper treating in the blacksmith shop. It seems unfair to take a piece of work that the tool room is proud of to the blacksmith and have him treat it. I think this should be done under the jurisdiction of the tool foreman, as he is more familiar with the uses to which the tool will be put.

W. T. Gale (C. & N. W.):—The duty of the demonstrator of the Chicago & North Western shops in Chicago is to assist any and every foreman in every department, in any manner, shape or form that he possibly can to expedite the work. It is his duty to look out for all the weak points. The foreman in a shop where they are rushing work as we try to rush it and get results, applies himself to the immediate necessities of his position, and in the hurry and bustle necessary at times may overlook essential details. The demonstrator is supposed to be looking for these and to strengthen shop organization. He has complete supervision over the work of the machines, as well as the manner in which the men perform the work in the various departments. He is supposed to be a practical machinist, a man who has gone through the shop, and who has held the position of foreman of one or all of the departments. He must be somewhat of a diplomat and must approach the men in different ways and make suggestions pertaining to the results they are trying to achieve. It is his duty to show them the manner in which they can get better results. At the North Western shops he has supervision over the apprentice schedule and has the direct welfare of the apprentices at heart. He is sent out from time to time to visit other shops and pick up ideas and present them to the management. He is supposed to note the condition of various machines and to make suggestions pertaining to machinery that has not the proper capacity or has become obsolete. He makes suggestions from time to time as to the handling of the men, placing and grouping of the machinery, etc.

G. H. Logan:—Mr. Gale was my successor as demonstrator. I think primarily the demonstrator was installed to get from each machine and each man a maximum output. My first duty was among the men on the machine side. I was to stay by the men and bring the output up to the capacity of the machine, as well to break in new men on the machines.

W. Smith (C. & N. W.):—The Santa Fe has inspectors who relieve the gang foremen and erecting foremen from following up any work. They see that it is properly put up and that the engines are right before they are fired up to make their trial trip. It seems to me it is a good thing to check up all power work before it has a chance to go out on the road and fail.

W. W. Scott:—I would like to ask Mr. North how he uses two or three different demonstrators?

L. A. North:—It was something entirely new to us when they were installed six months ago, and we went at it rather gradually. The demonstrators report to the foremen they are working under and are subject to their orders. The results we got when we put a demonstrator in the bolt gang were surprising. We had a fairly capable man in charge, but in looking over the situation we found that it was about as weak a place as we had in the shop on account of having apprentice boys in it, and the foreman was often absent checking off the work on the pit side; in five days we could notice such a decided improvement that we decided to put on as many demonstrators in the shop as we would be allowed to. We have three demonstrators on the machine side, and one on the erecting side who is now looking after the safety appliances on locomotives to see that they comply with the law. On the machine side one is working in the rod gang and on the new milling machines we have installed there. One is working in another gang and the third one is a general demonstrator going around wherever the machine side foreman sees fit to place him.

H. G. Dimmitt (C. M. & St. P.):—I visited one of the smaller shops of the Soo, and the foreman of the wheel shop told me that they had had a shop demonstrator in the shop for about a year, whose work had been to cut down the cost on all the different operations. The wheels, for instance, as they were pulled off, instead of being handled by hand are simply rolled on to a hoist that automatically lifts the wheel and sends it outside. Everything moves forward without any confusion, and a system of trolleys and devices cuts the cost very low and enables a few men to do a great deal of work. They assign the demonstrator to some particular operation and let him work at it until he gets it working as efficiently as is possible.

The following resolution relating to shop demonstration was passed at the closing season of the convention. Resolved, that we, the International Railway General Foremen's Association, in convention assembled July 26, 1912, after due consideration and discussion, do favor the adoption of a shop demonstrator in all locomotive repair shops consisting of fifteen or more engine pits.

ROUNDHOUSE EFFICIENCY.

William Hall, general machine shop foreman, Chicago & North Western, Escanaba, Mich., read a paper on this subject of which the following is an abstract:

The eyes of the railway world are centered on the problem of reducing the time locomotives are out of service from various causes, or in other words, time elapsing between the arrival of locomotives at terminals, and the time they are ready for service again. At large terminals, but more especially at points where the power is limited, much depends on the quick despatching of locomotives. This quick despatching calls for the hearty and responsive co-operation and concerted action of all parties concerned—including roundhouse foreman, road foreman of engines, engineers, hostlers, and heads of other departments.

The roundhouse foreman should be closely identified with the transportation department, so as to get all the information he can as to the time of departure of the power. He should be capable of looking and planning ahead, watching the company's business as he would his own, and should have the support of his superiors, a good organization, a sufficient amount of help, and last, but not least, a good supply of facilities to enable him to cope with the situation under all conditions, without which all his own efforts, far sightedness and energy will not count for much; but on the other hand, if the man at the helm has all these facilities at his command, but does not use good judgment, is not quick in thought and action, he is a failure and does not make for efficiency.

The road foreman of engines can help quite materially in bringing the efficiency of the roundhouse to a high standard by educating the engineers and firemen under his supervision in making out their reports accurately, leaving the fires in good condition, etc.

It is essential to the maintenance of the efficiency of the roundhouse that it be a clean, light and comfortable place for the men to work in; efficiency is dependent on a man's willingness as well as his ability, and willingness is influenced by his surroundings. I have seen roundhouses so dark, so poorly heated and ventilated, that the men could not do efficient work, and but for their loyalty to the company would not have remained at their posts. Such conditions as these handicap the most efficient of men.

Engines should also be kept clean, for many a failure from fractured frames, fractured rods, loose eccentrics, etc., would have been avoided had these defects not been covered up with dirt and grease; and right here I wish to say that we can learn not a little from our friends in Europe. Their engine houses are kept clean, light and airy, and their locomotives are kept clean, and the railway companies consider it money well spent. Defects can be more readily seen, men will do more work, and it has a good moral effect on the men in general. The cleanliness of the power also acts as a good advertisement, as the public takes a delight in looking at and commenting on a good clean-looking locomotive.

The efficiency of the roundhouse is not based entirely on the quick despatching of locomotives, but also on the number of miles each locomotive will make without a failure being recorded against it, and the best method of promoting this kind of efficiency is to do good work in the roundhouse.

Every engine house should have its own equipment of modern tools, entirely separate and distinct from the back shop—the two should be segregated. In fact, it would be far better if they were far removed from each other, as then the roundhouse would not be depending upon the back shop for support. If any branch of railway service needs and should have good tools it is the roundhouse. Engine houses at division points should have an engine lathe, a small lathe for brass work, a drill press, a small planer and an emery wheel, and such other tools as will tend to facilitate the work, the number and size to be governed by the size of the house; also a sufficient number of men to insure prompt service. To promote roundhouse efficiency considerable attention should be paid to shop kinks—taking advantage of every device that will facilitate operations and decrease the cost, such as air hoists, small portable cranes, benches, etc.

The next essential thing in the promotion of efficiency is a good organization, without which it is useless to look for efficiency. The work, as far as practicable, should be specialized, as more will be accomplished by this method. The men become more proficient along their different lines and will use their ingenuity in devising little devices and kinks to help themselves along. If thought advisable the men could be changed around at intervals, which might stimulate their interest in the work. Another aid to roundhouse efficiency is a hot-water plant for washing out purposes and refilling boilers after washing out, thus avoiding undue strains and stresses; much time is also saved, especially in cases of emergency. One or more good drop pits at suitable places in the house should be a part of the equipment for removing engine truck wheels, tender wheels, and, if necessary, driving wheels.

The coal chutes, water tanks and sand towers should be in close proximity to each other, and should be so arranged that in the despatching of engines there will be no reverse movements. It is essential to roundhouse efficiency that a sufficient number of hostlers be on hand, so that immediately an engine arrives it can be handled without delay and delivered to the house, when the foreman having his work slips arranged can line up his men and get an early start on the needed repairs, and by keeping in constant touch with the transportation department can advise them when they can reasonably expect certain power; they in turn can reciprocate by furnishing the roundhouse foreman advance information relative to breakdowns, etc., thus giving him an opportunity to make the necessary preparations. The inspectors should be alert and on the job at once, losing no time in making their inspections before anyone else has had a chance to do anything, as fractures will be more readily found.

A fair supply of staple articles should be kept in stock so that no delays may ensue while parts are sent for from headquarters. I believe that a long step in the direction of efficiency would be taken if all work was inspected after its completion, for then the careless man would be detected and failures from carelessness would be eliminated.

Discussion.—This paper received a most thorough discussion, the more important parts of which are reproduced herewith.

W. F. Fowler (Nor. Pac.):—As applied to roundhouses the term efficiency is a broad one and must be viewed from many sides; the principal objects to be sought after are, maintaining power at a reasonable cost with minimum delays from failures on the road and maximum time available for service on the road. Low costs represent efficiency only when accompanied with high mileage per engine failure and a high average mileage per engine per month, and high mileage between general repairs. To accomplish these results requires a high degree of organization. A modern locomotive represents an investment of from $15,000 to $20,000, and its earning capacity is variously estimated at from $25 to $100 per day. If by judicious management the roundhouse organization can keep the engines in service twenty-nine days in every thirty, instead of twenty-five, a service has been effected which will result in handling the same business with less engines. In other words, the earning capacity of each engine has been increased and this in turn would justify a slightly greater expenditure to accomplish these results.

To accomplish satisfactory results the first and most essential factor is a sound and flexible organization and the most important thing in securing it is proper and adequate supervision. The roundhouse foreman should have a staff of assistants such as to prevent his being over-burdened by detail work. On the other hand too much supervision results in loss on account of increased cost and the tendency of men to overlap their authority when their time is not fully occupied.

The roundhouse foreman must be supreme in his field and to him should go all criticisms and suggestions, he in turn to issue them to his different assistants, or to the men direct, as the case may be. The practice of master mechanics or higher officers interfering with the roundhouse foreman's authority is

an exceedingly pernicious one and leads to a weakening of the foreman's authority, and sooner or later is bound to create a certain feeling of disrespect of his position which will react on the whole organization and will result in a divided responsibility that is one of the worst enemies of a good organization.

The secret of a perfect organization in a roundhouse, as well as in any other department, is to have all branches of the work so covered that some one man is responsible for every different job. When this feeling of responsibility has been clearly defined and each man has been made to understand exactly what his duties are the first steps for a good organization have been laid.

The roundhouse foreman must keep in close touch with the transportation department and be fully conversant with the requirements in the way of power and the approximate time it will be required for service. It is equally as important to know when each engine is expected to arrive and to know promptly on arrival the character and amount of work which will be required to place it in proper condition to go out again. The assistant foremen in charge of the workmen must keep in close touch with the condition of the power and by frequent consultations with their chief plan their work so that proper repairs can be made in the most convenient manner. Too much time is lost in many places by failure to plan ahead. An engine which requires some heavy machine work should be placed as near the shop as possible, while an engine which possibly requires only a visit from the wipers and inspectors can better be placed in the stalls farthest from the working center.

Our modern boiler-washing plants have shown what close attention to details can produce in the way of efficiency, and they are a further daily evidence of the truth that a saving properly effected in one department usually results in a saving in others closely allied to it, for we have found that with reduced cost of doing the work has also come increased time the engines are available for work, increased life of staybolts and flues and a great reduction in the possibilities for failures from boiler troubles.

Under the head of specialization should come not only specialization in assignment of work to various men, but also specialization in the methods and manner of doing various jobs. Proper incentives should be offered to each and every one to make suggestions in the line of improvements, and not only should all such suggestions receive due consideration but also full credit should be given to the originator of the idea or suggestion. Too much cannot be said about this important factor in building up a strong organization and getting the very best results. The gang boss, assistant foreman, general foreman, or master mechanic, who is not broad enough to give his men credit for any idea or suggestion made by them cannot hope or expect to long hold the respect of his men. As a rule the facilities and tools available at an ordinary terminal are not always the best and if an organization can be developed where each man is planning and scheming to overcome inherent weaknesses in equipment or facilities by simple effective means a vast stride in the direction of higher efficiency will result.

The salaries paid foremen and assistant foremen should be enough greater than those of their subordinates to make the position one to be sought after and enable the road to secure the highest grade of service. You cannot expect to get the best possible results from a roundhouse foreman when some of the skilled workmen, who only put in nine hours regular service each day with practically no responsibility, get nearly as much, if not more, pay than he does. If the foreman is not worth more money as an organizer and supervisor of work, then he should be changed and a competent man put in his place.

Another important matter bearing on roundhouse efficiency is the facilities provided for the personal comfort of the men. Proper methods of ventilation, sewage system, heating and lighting are of the utmost importance. It is hard even when paying extra high salaries to secure and keep good men when working conditions are unpleasant. Neatness is absolutely necessary and the man who will not be neat and clean, orderly and careful as regards his surroundings will not exercise these same qualities to any marked degree in his work.

W. W. Scott (Pere Marquette):—As soon as the engines are brought in the inspector goes over them and makes out a report, which is coupled with the report of the enginemen. The clerk copies it and places it on a clip which is located on a post at each pit. When the work is completed it is signed by the workman who does it and the report is turned in and kept on file for thirty days. In case of an accident we can refer to our files and see just what the condition of the engine was when it arrived at the terminal. It also checks up engine failures. We have also installed a large board, known as the O. K. board, and when an engine arrives it is the duty of the hostler to place its number, the time of arrival and the pit number on the board. There are spaces opposite the engine numbers for each class of work and as the work is completed an O. K. mark is placed in the proper place. If the roundhouse foreman wants to know the status of any particular engine he simply refers to the board which shows it at a glance. We make it a practice in case any defect is found in the work that might lead to an engine failure, to allow the inspector a little bonus of an hour's time, or something of that kind, which is usually left to the discretion of the roundhouse foreman.

E. F. Fay (Ill. Cent.):—A roundhouse organization of the utmost flexibility, reporting to one head is absolutely essential. A matter not touched on in the report, but which should receive consideration, is the delays between the time an engine arrives at the terminal and the time it is housed. At the places where I have worked, almost without exception the principal delays have been between the storage track and the engine house. A first-class roundhouse foreman, and a sufficient number of assistants reporting directly to him to cover all the branches of the work, is a requisite. I believe there should be one foreman who should exercise jurisdiction over the coal chutes, cinder pit and the watering and sanding of the engines and to also have charge of the hostlers.

We find particularly in the western country that there is ordinarily insufficient roundhouse supervision to carry on the work as it should be carried on. A good organization for a large roundhouse handling from 75 to 80 engines is a foreman, an assistant foreman in charge of running repairs, and an assistant in charge of the dead work. The work in the roundhouse should be specialized, and that on passenger engines may be done very advantageously by one or two, or possibly more, machinists being assigned directly to it, and being held responsible for it.

There is one thing I have never seen satisfactorily worked out. We all have traveling engineers who are supposed to ride a certain number of engines daily and make reports as to their condition; we depend on them more than we do the regular enginemen to keep us in touch with locomotive conditions. The engineers make out their work reports, frequently omitting some of the essentials that should be taken care of, but the traveling engineer's report invariably covers these matters. If we have not time to take care of all the work reported by the traveling engineer on his incoming trip, it is arranged so that the work will be taken care of the next time the engine comes in and in such cases it may be forgotten until we have a failure on the road. That is one of the things that I have never seen successfully worked out, although I understand they have a very good system on the Lake Shore.

In most roundhouses we have what is known as a daily transfer between the day roundhouse foreman and the night man, and vice versa. The master mechanic or the general foreman, or whoever may be in charge at that point, should be conversant with the details of these transfers, and a copy of this turn-over should be sent to him daily. This could be arranged

by having the roundhouse foreman use a loose sheet with a carbon on the page of the transfer book, sending the original to the master mechanic and leaving the carbon copy on the book for the use of the on-coming foreman. This transfer should cover anything unusual which may have occurred and also any failures of which the foreman might be cognizant. Enginemen should be instructed to detail any unusual delays that they have encountered on the road, due either to engine or cars, though not considered engine failures; this will keep the roundhouse foreman posted as to operating conditions. This roundhouse turnover should be in the nature of a log book and all of the extraordinary happenings should appear and should be made a matter of permanent record.

Coaling engines with a coaling crane has been adversely criticised. There are places where coaling cranes have been used advantageously, and one of the largest railway systems in this country uses it exclusively for coaling engines, and coal is being handled at a cost of 2½ cents per ton. There are very few mechanical devices that are handling coal at less than 2 cents a ton, and considering the amount of money invested, they are not making any showing over the crane at that figure. The following plan is used on the Southern Pacific: A trestle is provided that will hold ten or twelve, or as many cars as are considered necessary. The coal is dumped from cars on this trestle. A section man in one hour and 30 minutes will dump 16 cars. The coaling crane is on the trestle and coals engines directly from the receiving dock below; it also loads cars for other places, cleans the cinder pit which is parallel and adjacent to the coaling dock, and fills the night coal bunkers, which are arranged on one side with a sufficient capacity for night requirements. The crane operator is paid $100 a month, and he has a helper at about $65. One hour a day of the section man's time is charged to dumping the cars. There is seldom a delay for coal because of a crane being out of commission, as ordinarily a second crane is provided. The engine makes one stop for coaling, sanding, watering and ash pan cleaning.

It is an excellent suggestion to have the engine board show all the various items of work on each engine. That ought to be worked out everywhere so the roundhouse foreman or any one else, would know the condition of the power by glancing at the board.

The bonus, mentioned by Mr. Scott, is a new idea to me except for covering rod fractures. I agree with Mr. Hall that the roundhouse work should be segregated from that of the back shop. Make the roundhouse foreman responsible for the roundhouse and give him the finished material to put up and let him take care of it. A great many of us who are operating repair shops and roundhouses that are close together realize how dependent the roundhouse foreman becomes on the back shop, and how when anything is missing he feels that he cannot wait a few minutes longer until repairs can be made, but must rob the back shop. It tends to reduce the efficiency of the back shop and decrease its output.

In a great many places it is the practice to have a clerk in the roundhouse office, frequently termed an engine despatcher; he answers the telephone and looks after the roundhouse reports and the reports incident to periodical inspection, roundhouse correspondence, keeps the boiler washing record, relieves the roundhouse foreman of a great deal of clerical work, and gives him more time to devote to the supervision of roundhouse repairs. I believe we would find almost invariably that the expense of such a clerk in the roundhouse is covered by the increased efficiency of the roundhouse organization. It should not be necessary for a roundhouse foreman to sit at his desk to exceed thirty minutes a day.

Our enginemen furnish a work report. We have an outside inspector whose duty it is to replace missing nuts and cotters and to adjust the rod wedges; also to report any defects he may discover. We also have an inside inspector who goes under the engine, and a cab inspector who looks after the cab inspection and the condition of the bell ringer. We have a federal safety appliance inspector who looks after the condition of the grab-irons, height of couplers and brake cylinder piston travel.

G. H. Logan (C. & N. W.):—We have one engine inspector who inspects the machinery and details during the day and one at night. The staybolt inspection is made by a boilermaker who has been assigned as an inspector to comply with the requirements of the federal boiler inspection law. He must be present at all hydrostatic tests, make subsequent internal inspection, set the pops on all engines out of the shop and make the quarterly gage and pop tests on such engines as come in on which this inspection is due. At night this work is taken care of by a boilermaker and a machinist, who jointly fill out boiler form No. 1 and the quarterly cab card. As far as possible all tests and inspections are made during the day by the regular inspector.

L. A. North (Ill. Cen.):—Engines should be kept clean. It renders a fracture or crack, or anything that may cause an engine failure, more noticeable, and has a tendency to create a much more favorable impression on the traveling public. I think a wiping gang is just as important to good roundhouse management as good machinists.

E. F. Fay:—We have a special man who adjusts all the wedges and sees that all the eccentrics and set screws are in place and properly tightened.

R. B. Van Wormer (A. C. L.):—In my opinion it is very necessary to maintain a stock of repair parts in the roundhouse that can be utilized on engines coming in with worn parts requiring repairs. If the parts removed are then repaired they can be returned to the stock and the stock maintained at all times, thus facilitating the more rapid handling of the locomotives in the engine house. The engine on its way to the turntable should have the ask pan cleaned and cool water and sand supplied as quickly as possible in order that as much time as possible may be devoted the repair work. It takes about seven minutes from the time the engine reaches the clinker pit until it is on the center of the turntable at Waycross. One man has charge of the coaling of engines, as well as the unloading of the coal, the clinker pit and the sanding of the engines, although he is not in direct charge of the hostler. Speaking about the co-operation between the back shop and the roundhouse foreman, I think it will be found that if the engine house will maintain a supply of repair parts and keep a full line of everything that it is believed will be required from time to time, it will be practically independent of the back shop.

T. J. Mullen (L. E. & W.):—We use the same system of reporting work that the Lake Shore does. When an engine arrives at the terminal the engineer comes into the roundhouse after inspection of the engine and makes a report to the clerk who copies it in a work report book. He then copies each item on a separate slip that shows which clerk handled the report, the engineer's name, the engine number, the date and the work necessary to be done. We have a number of little file boxes, one for the machinist foreman, one for the boiler foreman, one for the tin and pipe man, one marked "unfinished work"; also one for the back shop so that in case an engine goes to the back shop the slips in it may be handed to the erecting shop foreman. When each item of work has been completed the man who handles it O. K.'s the slip. If the foreman in looking over the slips before he distributes them sees something that he thinks is unnecessary, he inspects it himself. If he decides it is not necessary he marks on the back of the slip "O. K. for service," and places it in the unfinished box. Sometime later he catches it when he has more time to do the work. In case the men cannot finish the work that has been assigned to them before they stop work for the day they

hand the slip back to the day foreman and they are put in the unfinished box, and the night foreman distributes them just as if the engine came in at that time. After the work has been completed the slips are filed in a case under the proper engine number and are kept there for 30 days, after which the clerk ties them up in a bundle and puts the engine number on the outside. In case the engine should have a failure, all the master mechanic or traveling engineer, or roundhouse foreman has to do is to refer to the case and see who worked last on the part that failed. The master mechanic and his clerk come down to the office of the roundhouse about once a week and take the slips out of the case and check them up with the report book to see whether any of them are missing. The inspector makes his report in the same way as the engineer does, or, if the master mechanic should see any defect, he reports it, and it is put on the book and a slip made out with his name on the back showing who reported the work. The best feature of the system is that the master mechanic or clerk checking over the slips once a week has a strong tendency to make everybody turn in his slip. In case a slip is not turned in, we hold the roundhouse foreman responsible for it.

Thos. Zinken (C. H. & D.):—I am advocating that the roundhouse foreman should have off at least two Sundays a month. It is an exceptionally hard task to be a roundhouse foreman now-a-days because of the federal requirements, and he is deserving of this consideration.

H. G. Dimmitt (C. M. & St. P.):—We do not work independent of the back shop, but have certain machines in that shop that do nothing but roundhouse work; it is up to the roundhouse foreman to say what work he wants done on these machines, and if necessary to advise the machine shop foreman that he needs more machines. The assistant roundhouse foreman has direct supervision over the boiler washers. We still hold the enginemen for a thorough inspection of their own engines. They have, however, been relieved of the inspection of passenger engines, except running inspection. On the arrival of the engine at the terminal it is inspected by one inspector who has to do with the safety appliances, another on machinery, and a third, the head boilermaker, who looks after the draft appliances, ash pans and the condition of the boiler. The interior of the boiler is inspected by the head boiler washer. The reports made out by the engineer, and also by the inspector are filed in the roundhouse office for 30 days, and after that they are filed in the master mechanic's office.

W. Smith (C. & N. W.):—One important thing that we have got to consider is terminal delays. They are very expensive and amount to hundreds of dollars at large terminals; it is a matter which can be sifted down the same as engine failures, or anything else. There is always a reason, and when a failure or a terminal delay occurs it should be investigated thoroughly. As an example, most of our engines are equipped with air operated fire doors, and we have had a few failures from the broken air pipe. It was found that it was caused by the engine washers when they inserted the nozzle of the hose in the back head, and after several delays of this kind we inaugurated a system of having these pipes inspected, and delays from that source have been done away with. Another thing that should be carefully checked is the matter of failures and the placing of responsibility. Most every engine failure can be traced to negligence on the part of somebody.

Portable tool boxes for the different wrenches and tools are great time savers and promote the efficiency of the roundhouse greatly. Another point is having the material on hand that is to be used in making repairs, such as gage cocks, lost motion shims for drawbars, tire shims, etc. Repairs can thus be made without any delay. Another thing is the monthly inspections that should be made in the roundhouse. Some of the roads go very extensively into this. The Pennsylvania and the Lake Shore are the foremost; on our road we examine cylinder packing monthly on freight engines, and on passenger engines twice a month. On superheater engines this is especially important, and I think a great many failures are eliminated by this precaution. I understand some roads anneal drawbars periodically. We examine the drawbars and drawbar pins monthly, but do not anneal them. We have the built-up piston heads and it is essential that they be inspected regularly so that failures may be eliminated as far as possible.

C. M. Newman (A. C. L.):—We have a book report of the arrival of all engines, showing the time of the engine's arrival, the time it is ready for service, and also a record of the time that each engine is coaled, the time that the crew is called, and the time that the crew reports. This helps in determining the dead time of the engines and also any overtime that might develop from some failure of the engine after it has been furnished to the transportation department. We also keep a log book. Anything out of the ordinary, or any changes are noted in it. The engineer's work report is deposited in the cab of the engine and is removed and taken to the roundhouse foreman's office and each item is copied on a separate slip. The inspector also makes report of any work he finds. These slips are turned over to the roundhouse foreman who distributes them among the men he wishes to do the work. After the repairs have been completed the slips are signed by the men who do the work and turned back to the assistant foreman, and they are held as records.

J. W. Anderson (C. & N. W.):—We ran 36 days without an engine failure on our division. We were all proud of it, and it was due not only to the organization, but to every man in the shop. Everybody watched the failure sheet, which is posted every morning, closely and did everything possible to prevent failure. Our engine inspector does not do any work on the engines. We found if we depended on him to do such work the inspection was slighted. We make monthly cylinder packing inspection on freight engines, and on passenger twice a month. We have not had any failures on account of cylinder packing or valve rings for I think five months, since we inaugurated the system. I have always felt that there were engine failures and man failures, and we find that the man failures exceed the engine failures.

We use blow-off cocks to a great extent on account of bad water. There is one on each side at the corner of the mud-ring, and the engineers will open them as high as 200 times in going 150 miles, just enough to blow out the small amount of mud that collects. It is a wonderful improvement and helps out with the boiler washing. After the water is let out one of us generally happens around to see the amount of soft mud that has collected, and if there is much of it we report it to the master mechanic and he gets after the engineer and fireman to see why they did not properly blow it out.

The air pumps are changed on passenger power every six months regardless of whether there is anything reported on them or not. Both pumps are taken to the repair department and overhauled.

MR. GOSSETT'S ADDRESS.

W. J. Tollerton, mechanical superintendent of the Rock Island Lines, was to have made an address at the Thursday afternoon session, but was unexpectedly detained and C. E. Gossett, general master mechanic of the Minneapolis & St. Louis, was asked to take his place. Among other things he said:

No doubt a great many of you think that you are underpaid; that you do not get money enough for what you really do. That is perhaps true in many cases, but the only way to get more money is to succeed at what you are doing and

demand then from your superiors an increased responsibility, which brings accordingly increased compensation.

We are today confronted with a labor situation that this country never knew before. What are we going to do with it? Labor conditions vary with the locality. Therefore it is up to each general foreman to cope with the situation at his particular point. There is no ironclad rule to be laid down that will govern the handling of labor today. We have got to meet it as it exists in the various localities.

We have monthly mechanical meetings. My office door is open once a month to the master mechanics, general foremen, roundhouse foremen, road foremen, shop foremen and any one else that may care to be present, and it is surprising to see how these meetings are growing. Engineers, firemen, fire knockers, sweepers, everybody, is welcome to them. Twice a week our master mechanics require their foremen to met them at the storekeeper's office. They go through the entire store stock and analyze all of the material on hand.

I would like also to call your attention to the apprentice situation. This is really more serious to us, when we take it home, than the labor situation. What are we going to do in a few more years for machinists? In employing apprentices we should absolutely insist on selecting our material from our home shop town. Get an engineer's boy, a machinist's boy, a foreman's boy, somebody that has got something back of him so that he can live in comfortable circumstances while he is learning the machinist's trade. On top of that, he should have a mother's care. A boy between the ages of sixteen and nineteen is not able to go out and cope with this world as it is today. If they do get out and get away from home they get before the machinists' organization. They are told how little to do, how little a machine will get out and still keep the general foreman and the shop foreman satisfied. They are not told how to get the maximum output of the machine. Therefore we should select our apprentices from material we know something about, and not only give them a proper training, but keep them in their home environment and under their mother's care.

SHOP SPECIALIZATION.

W. T. Gale, demonstrator, Chicago & North Western, read a paper on this subject, of which the following is an abstract:

I would refer to one of the largest railway repair shops in the western country, located in Chicago. It was erected in 1873, and consequently cannot be considered up to date along structural lines. It has twenty-four pits, one being equipped with a stationary hoisting engine for wheeling engines. There is no modern overhead traveling crane for the conveyance of heavy material. The erecting shop is of the transverse type with the machine shop on the opposite side. In 1906, with the addition of a few necessary tools to complete the equipment, and with an additional wing added to the machine side of the shop, the reorganization was begun. The plan was to complete one section, or gang, at a time in order not to delay or impede the progress of the regular output of the shop. The rod gang was the first to be arranged. It was located in the center at one side of the shop, and grouped around and in front of it, at convenient positions, were the necessary machines for the work, such as drill presses, slotting and planing machines, boring mills, shapers, lathes, millers, hydraulic press, bolt machines, etc. Wall bracketed overhead swinging air lifts were erected over the rod benches at regular intervals between each operator's station. A traveling roller bearing circular overhead lift was erected between the rod horse benches and the machines, with which the rods could be passed from bench to bench, from one end of the gang to the other in a very few moments, or, when necessary, fed to the various machines, as occasion required.

This work having been rearranged satisfactorily, the driving box and cellar work was taken up and treated in a somewhat similar manner. Drill presses, planers, shapers, lathes, boring mills, hydraulic press, babbitting furnace, jigs, and other necessary machines and appliances, were all grouped together, forming one complete homogeneous system for handling the work correctly and expeditiously.

The same arrangement was made in connection with the link motion work, pistons and piston rods, valves, etc. Special men were selected according to their various qualifications and placed on machines doing a special class of work, such as planing or milling main and side rods, shaping, turning and boring rod brasses; planing, boring and slotting driving boxes; turning, fitting, grinding, milling and fitting up pistons and piston rods, etc. Drill presses were placed in suitable positions opposite to and near erecting shop gangs that had work of this kind; gang lathes were run by apprentices; Gisholt and bolt machines were placed adjacent to erecting gangs. All heavy machinery, such as wheel lathes, hydraulic press, quartering machines, large planers, slotters, radial drill press, etc., were alined near the center of the shop.

On the erecting side of the shop was placed a series of overhead traveling hand-power air hoists parallel to the length of the shop and in front of the engines. Over the rear end of the engines and also parallel to the length of the shop was placed a series of overhead traveling hand-power circular air hoists, and these hoists were used in lifting front ends, driving rods, pistons, driving boxes, etc. Special men were then selected, as on the machine side, and placed on special work; they were given special tools, such as air hammers, drills, taps, valve-setting motors and cylinder boring tools, etc., and were considered as specialists for work in all erecting shop gangs. They were subject to the call of the gang foremen, as required, and were directly under the orders of the erecting shop foreman. Their work consisted in taking care of all operations that heavy and general repairs call for in the locomotive repair shop. About sixty men were placed in this way, doing special work assigned to them, and that kind only.

As a still further improvement, and in order to facilitate the repair shop work as fast as it consistently could be done, all shop orders or requisition work that had formerly been done in the back shop, was transferred to another shop, which had been prepared for it. Here the same order was maintained pertaining to the specialization of men, work, and tools. This department, being supplied with a large number of special tools, jigs, etc., it became necessary to take special care of them, which was done in the following manner: A series of special cupboards were arranged with shelves placed in them. The cupboards and shelves were lettered and numbered; wooden boards 14 in. x 2 in. thick with recesses cut in them for holding box tools, special drills, forming tools, reamers, taps, dies, etc., were placed in the cupboards in numerical order. The various machines, being numbered and lettered to correspond to the boards, a chart was arranged with the letters and numbers, which showed at a glance the location and kind of tools wanted for the particular kind of work and machine. This saved many unnecessary steps and considerable time in getting tools and starting on the work.

This same general plan of specializing was installed in all the shops under the motive power department, and it has been generally conceded by representative motive power executives who have visited and studied the system at these shops, to be an exceedingly efficient and economical method of facilitating the output. This plan of specialization having been in operation for several years, seems to justify its continuance, and has in many cases been adopted by other roads with considerable success.

There is small demand for the jack-of-all-trades. It is the expert who is accomplishing the big things, and it is the expert who is getting the reward for his knowledge and ability. It is the specialist who gets special results.

Discussion.—The subject was discussed at some length and the important points brought out are as follows:

L. A. North (Ill. Cen.):—We are interested in manufacturing material to the best advantage. For instance, suppose a planer will take two complete sets of shoes and wedges. If it is filled up and both heads set to work they can be much more economically handled than if only the one set, which might be needed at the time, was furnished. This is only one of a number of items which might be treated in the same way.

G. H. Logan (C. & N. W.):—I think we are all in accord with Mr. Gale's idea of shop specialization—the concentration or assembling of certain parts of the engines to be repaired in one particular place or in collective groups and having special men to take care of these special parts. We know that it goes for an increased output, but I think specialization should be coupled with a time schedule for repairing the locomotives. All engines passing through the shops for repairs should have a specified time allotted to them for the different classes of repairs. The workmen in the various departments should have a knowledge of the date that every engine is to leave the shop. In this way the work will move along in proper rotation. It also eliminates a good deal of controversy that is apt to arise between the different gang bosses or foremen of departments. For instance, if I had an engine that I wanted some particular part for and the work was up to where I needed it, naturally I would get after the machine shop foreman if the work were in his department; but if some other gang foreman had an engine which left the shop a day before my engine and he was at work on the parts for that pa.ticular engine, I really would have no kick coming. Of course, to arrive at the proper amount of time to allot the respective classes of repairs is quite a proposition. If it takes you 200 hours on a general repair engine, establish a 200-hour schedule and see how nicely it works out. I think it would be only a question of time before the time would be cut down 50 hours or better. I can remember working in the gang for the North Western when we used to have 200 hours for a general repair engine. I believe the time now is cut down to 113 hours and things move along very smoothly.

W. Smith (C. & N. W.):—I have known of remarkable results having been obtained by rearranging machines with regard to trucking and light. The question of light is a very important matter to be considered, and the output of many back-number shops could be greatly increased by such rearrangements.

C. L. Dickert (Cen. of Ga.):—Specializing work is carried as far as practicable at our shops. In my opinion, this means of handling work is the most effective, as the men become more efficient in one class of work than you could possibly expect on general work. They know, when an engine is shopped, that they will be held responsible for the work regularly assigned to them, and they will anticipate their wants and get up such stock as they think they will need in order to keep ahead. They have all the tools necessary to do the work assigned to them, and keep their tools in good condition. They also pride themselves in getting up handy and time-saving kinks that they would not think of otherwise. I find the special men will exert themselves to have their work finished when needed, so as not to be behind. If their work is not promptly delivered to them when an engine is stripped they make a kick. They soon become familiar with the standards and working prints of their line of work, and when information is wanted and questions asked about it are in position to furnish it. Where the work is specialized it gives the foreman more time to look after things in a general way and not have to follow up every little detail.

As a general rule, the men are not in favor of specializing the work, but after they are on the job they seem to take more interest than they do on roustabout work. I have tried handling the work both ways and find we accomplish 25 per cent. more by specializing. In the erecting shop we have special men on squaring engines; special men on valve setting; one man on guides, valve seats, steam chests, and cylinders; two on cab work, including cocks, throttle levers, reverse levers, whistles, safety valves and water glasses. Another looks after steam and exhaust pipes, throttle boxes, dry pipes and front ends; one on cylinder cocks and rigging, bells, tank hose and fittings. In the machine shop we have a man who does the fitting up of driving boxes; one man who attends to valves, yokes, pistons, rockers and arms. We have a special rod gang, link gang, gang foreman of turret group, a brass group and a wheel group. By having a head to each class of work you have only one man to deal with directly, where if one man was on the job today and another man tomorrow it would be a hard matter to keep up with the work. When an engine is stripped the distributing gang knows just where the parts belong and delivers them to their respective departments, and the same gang is used to place the work at the engines when finished.

The first of each week the erecting foreman makes out a list of engines, giving a copy to all department heads and special men, showing which engines are to be given preference and placing them on the list in the order in which they are to be turned out. If any department, or special man, sees where he cannot finish by the time set he notifies the erecting foreman, who investigates the trouble.

R. V. Van Wormer (A. C. L.):—Within the last two years we materially increased the output, principally by specializing the work; in some cases we moved machines to new locations better suited to the conditions and the work. Most of our tools are independent motor-driven, with a few small group drives. We also standardize different parts of our locomotives and carry a fair supply of these parts ready to replace worn parts as the engines come in for repairs.

W. G. Reyer (N. C. & St. L.):—We do our tempering in the toolroom with a gas furnace, getting better results than when it was done by the blacksmith.

W. T. Gale:—We have the tools grouped for driving-box work. The boxes are brought over from the vat after they are cleaned and are placed in the gang, where the brasses are taken out and the liner stripped. The drill presses and the planer and shaper for the brasses are all adjacent to each other. We have a series of overhead cranes for passing from one machine to the other.

THE RECLAIMING OF SCRAP.

Three papers were presented on this subject by different members of the association; abstracts of these follow:

Mr. Hall's Paper.—William Hall, general machine shop foreman of the Chicago and North Western at Escanaba, Mich., said: That there is a great deal of money to be made or saved from the scrap piles is without question. In the first place, a practical man who is familiar with the different parts of both locomotives and cars should be in charge of the scrap bins, a man capable of using good judgment as to what should or should not be consigned to the scrap pile, and who will pay strict attention to the proper sorting and classification of the scrap. To reduce the cost of handling this class of material to a minimum it must be handled in a scientific manner and in such quantities as would justify the cost of a reclaiming plant. Such plants are now in operation on a number of roads.

The first and great mistake is in allowing good, usable material to get into the scrap, for if it can be taken from the scrap pile and made as good as new it should have been used up in the first place. If, from any cause whatever, through a change in

class of power, etc., good, usable material should accumulate, it should be returned to headquarters as such and not as scrap, thereby saving the cost of extra handling. A reclaiming plant should be established at all division headquarters with a sufficient force to handle it economically, and would prove to be a paying investment; the plant to be in proportion to the size of the division and the amount of business done, thus avoiding shipping to headquarters.

The Chicago and North Western has gone into the reclaiming of material on a large scale and in various ways. At the Chicago shops we have a reclaiming shed 24 ft. x 176 ft, which contains the following tools: One steam hammer, one bulldozer, one double shear, one large single shear, three machines for removing nuts from bolts, one 25-lb. spring hammer and one Bradley hammer. This shed was built from lumber reclaimed from old torn-down cars, and the tools were removed from the blacksmith shop to make room for more modern ones. All the reclaiming is not done in this shed, however, as a large quantity is handled in the blacksmith shop and the machine shop. In the reclaiming shed all usable bar iron is straightened and cut up for bolts, etc., and the scrap is sent to the blacksmith shop, cut up, heated in a large furnace and then hammered into slabs, and they in turn are converted into axles.

At the Winona, Minn., shops we have a reclaiming shed 30 ft. x 100 ft., containing one small drill press, one triple head bolt cutter, one combined shears and punch, an emery wheel, one steam hammer, two ordinary blacksmith fires, one long fire, a screw press, vises and a straightening plate. This shed is manned by a foreman, two blacksmiths, two helpers, one bolt cutter, two laborers and a boy.

At several points on the system we have plants for the reclaiming of old waste taken from the journal boxes of both locomotives and cars. It is renovated and soaked in oil for a certain length of time and then allowed to drain, and is ready for use again; any waste having babbitt adhering is burned and the babbitt saved. Old car sills are used for flooring in roundhouses and other buildings, or wherever they can be used to good advantage. Old driving box grease is melted in a steamer; the foreign substances settle to the bottom and the grease is then used for rod lubrication with good results. Old boiler lagging is ground up in a home-made machine and used over again. Valves, nuts, bolts, washers, spikes and old car springs are reclaimed. When old cars are torn down all good siding, lining and other parts are used for patching or for building purposes, and the scrap wood is used for firing up locomotives; the iron parts are used over again to a great extent. I think I am perfectly safe in saying that a saving of $1,000 a month is made on material that was formerly burned up. During the year 1911 a saving of $50,000 was made on old bolts alone, and the saving on nuts, track spikes and brake lever pins in the same period was in the neighborhood of $26,000.

During the month of October, 1911, a total saving of $12,881.36 was made; November, $9,989.86; December, $8,655.31; January, 1912, $8,192.16. These figures represent the saving on reclaimed material for the entire system. Following are a few samples of reclaimed material at our Winona shops:

December, 1911.

Amount reclaimed, $1,282.57; scrap value, $270.59; labor, $286.92; total saving, $725.06.

11,781 bolts recut—Labor $57.14, scrap value $64.27, reclaim value, $280.51; total saving, $159.10.

4,440 nuts retapped—Labor $32.61, scrap value $24.41; reclaim value, $133.55; total saving, $76.53.

Twelve car doors, $24—Labor and material, $16.79; total saving, $7.21.

January, 1912.

Amount reclaimed, $808.75; scrap value, $203.63; labor, $218.15; total saving, $386.95.

7,730 bolts recut—Labor $50.21; scrap value $59; reclaim value, $183.98; total saving, $73.78.

3,128 nuts retapped—Labor $17.32, scrap value $22.70; reclaim value, $60.46; total saving, $20.44.

Ten car doors, $20—Labor and material, $12.87; saving, $7.13.

February, 1912.

Amount reclaimed, $1,500.33; scrap value, $231.02; labor, $262.74; total saving, $1,006.57.

15,500 bolts recut—Labor $71.16, scrap value $86.71; reclaim value, $438.10; total saving, $280.23.

2,220 nuts retapped—Labor $27.75, scrap value $11.50; reclaim value, $98.61; total saving, $50.36.

Twelve car doors, $24—Labor and material, $18.73; saving, $5.27.

The foundry is another source of revenue for reclaimed material. All scrap car brasses which have not had the babbitt worn through and are not defective are put into a melting out furnace and cleaned of all foreign substances; they are then tinned and rebabbitted. This saves the melting up of the scrap material, making of new shells and boring them. During the year 1911 a saving of about 50 per cent. was effected.

All cinders and clinkers, ashes and slag from coal and oil furnaces are cracked into small pieces and washed in a revolving washing machine. All sweepings from the foundry are also put through this washing machine. It is so arranged that the dirt is carried away by water and the brass remains in the washer. These washings are then used in making new car brasses. The babbitt melted out of scrap car brasses is poured into ingots and allowed to accumulate in lots of about 50 or 60 ingots; from these sample drillings are taken and analyzed. The proper metals are then added to bring this up to a standard metal and it is used instead of new material. A large saving is effected by this practice. Scrap copper from batteries, scrap copper wire and scrap headlight reflectors are all melted up and used in the manufacture of brass. Brass borings containing babbitt, steel or iron are run through a magnetic separator and used in the manufacture of brass also. Driving box brasses, rod brasses, etc., are melted and used again for making similar brasses. Locomotive bells are remelted and recast into bells. Scrap red and yellow brass, such as is found in injector parts, globe valves, etc., is melted and used in the manufacture of red and yellow brass.

Mr. Voges' Paper.—C. H. Voges, general foreman of the Big Four at Bellefontaine, Ohio, said: It would pay any company, where a large quantity of wrought iron scrap accumulates, to install a furnace and a large steam hammer to forge the material into billets so it can afterward be drawn out, as this is much cheaper than purchasing it from outside points. We have to keep a large amount of cast iron and brass castings on hand to protect ourselves and outside points. It would pay any large railway to install a foundry for both cast iron and brass. It would cut the amount of stock on hand to a minimum.

We have a large bin in which we keep all scrap brass. This is divided into six equal parts and has six separate covers. There is a long rod 1 in. in diameter that extends the full length of the bin and a bracket on each end holds it in place, while a padlock is placed on one end to hold it and keep it from being opened. Each part has a sign on the cover which designates what kind of scrap it contains. No. 1 contains phosphor bronze, which includes half-moon brasses, rod brasses and driving box side liners. No. 2 contains engine brass, which includes small parts such as gage cocks and stems, cylinder cocks, valves and engine truck brasses. No. 3 contains car brasses, No. 4 phosphor bronze turnings, No. 5 engine brass turnings and No. 6 sheet copper and pipes.

When an engine is being stripped for repairs the gang foreman in charge has all the worn and broken parts thrown in the center of the track at the rear of the engine and the shop laborer remove it to its proper place, the foreman giving the engine credit for the amount of scrap. All hexagon nuts are taken to the tapping machine and the operator retaps them and they are taken to the storeroom, where they are given out free of charge. Old piston rods, bolts of all sizes, old driving axles, car axles and crank pins are taken to the smith shop, where they are used to make different kinds of forgings. The tin and copper smith foreman, who is in charge of such material as globe valves, jackets, and copper and iron pipes with fittings, inspects

it when it is removed from an engine, and, if it is found to be worn or broken, he gives the engine credit and throws it in the scrap if it cannot be repaired.

The following is not considered as scrap material. All good wool waste that is removed from our engine truck cellars, trailer cellars and driving box cellars is sent to the oil room and the engine is given credit for the amount turned in. We pick up all old waste around the plant which has been charged out and take it to our waste cleaning plant, where it is boiled, and, after it is cleaned, it is given out free of charge. We use this on freight tenders and freight cars and also supply different points on the division. This waste boiling plant was started on October 10, 1911, and we can clean daily on the average about 160 lbs. We have cleaned up to the present time 1,900 lbs. of cotton waste and 1,800 lbs. of wool waste. The attendant is a 15¾-cent laborer, and he spends about 1½ hours a day in looking after the plant. The dirty waste which has lots of sand and grease in it we send to outside points to be used in firing up engines. We use our journal grease and rod grease in the same way that the wool waste is used.

Mr. Ogden's Paper.—T. H. Ogden, general foreman, Atchison, Topeka & Santa Fe, Las Vegas, N. M., also read a paper on reclaiming scrap, of which the following is an abstract:

A considerable amount of care must be exercised to prevent serviceable material from finding its way into the scrap bin at small terminal points. Our system is to not allow any serviceable material to get into the scrap bin. We have a place provided in the shops where any such material, which is picked up by roundhouse sweepers, or in the yard by the yard cleaners, may be put, and workmen are instructed to use this material as long as it lasts before calling on the storehouse for new material. We also have platforms near our shop entrances, where such engine material as is serviceable, or has been repaired, is placed, and workmen draw from this platform such material as they can use. Any material that can be repaired by blacksmiths, or otherwise, is also placed on this paltform and is used if possible before drawing new material from the storehouse. A platform is also placed near the entrance of the blacksmith shop, where all pieces of iron of serviceable length are placed. This iron must be used before going to the iron rack at the storehouse, and the storehouse is the last resort.

Again, surplus material fit for service will accumulate at division points, and this should be turned back to the storehouse and credit furnished. In this case a working memorandum should be furnished covering reclaimed material and complete instructions for accounting for all such material which may be returned to stock. For instance, it may be required that all serviceable material may be returned to stock until needed. This actions affords a record on the stock books for any available material for use and very often enables the redistribution of such material, avoiding the purchase of new parts.

When foremen order new material they should show on the requisition when serviceable parts are to be displaced, and this would permit a closer check of the material that usually finds its way into the scrap bins when it should be reclaimed at once when removed.

Discussion:—The discussion of this subject was alive and brought out many valuable points.

C. L. Dickert (Cen. of Ga.):—In the car department we have a platform with fifteen scrap bins, each labeled for the kind of scrap to be deposited therein; also an assorting platform, the whole spanned by a gantry crane. Everything in the way of scrap and second-hand material collected in the shop and repair yards is unloaded on the assorting platform, where a competent white man with a corps of negro laborers assorts the good material. All freight car forgings that are not broken are placed on a platform near the smith shop to be straightened, reshaped and re-applied to cars undergoing repairs. The bolts are sorted in sizes; all of the longer ones are straightened and re-threaded, the broken ones being cut off for shorter bolts. The nuts are collected and sent to the nut tapper to be retapped, and, with the re-threaded bolts and cut and cast washers, are placed in the sub-stores in the car department to be issued for repairs without charge. Our arch bar and coupler yoke scrap is straightened under an air machine, sheared and run through a splitting shear on our reclaiming rolls. It is then rolled into sizes to make ⅞-in. and 1-in. draft bolts at a cost of about 85 cents per 100 lbs. This, of course, includes the value of the scrap with a liberal shop percentage for maintenance added to the labor. The reclaimed iron is made into bolts on shop orders issued from the store department and the store is billed with the labor cost of producing the bolts plus the cost of reclaiming the scrap. On the output of this machine alone the difference in the price of reclaimed iron and the price of merchant bar iron amounts to several thousand dollars annually. Our good bar stock, salvage from wrecked or burned cars, is not handled that way, but is cut into lengths for bolts, brake staffs and other purposes that we can utilize it for.

To handle scrap and second-hand material properly, equipment other than a crane and magnet are necessary. We have a small power hammer for straightening bolts and other material, and a furnace for heating brake beams that we straighten with the heads and fulcrums intact on a home-made machine. We have also a hydraulic shear that we use largely for shearing yokes from couplers, a rivet furnace, a pneumatic riveter for riveting yokes on couplers, and last, but not least, a heavy alligator shear.

In the machine and erecting departments we do not have as much material that can be reclaimed or utilized for other purposes as in car shop, yet a considerable saving can be effected in many ways. Our scrap crown and side rod brasses are broken into small pieces under a steam hammer and melted in an oil furnace. With this we cast our hub liners on wheels and driving boxes. The broken tap shanks, worn out reamers that cannot be annealed and reworked, and, in fact, any other carbon tool steel scrap that is large enough, is made into chisels, calking tools and center punches for machinists and boilermakers. In the last six months our tool dresser has made by actual count 318 hand chisels at odd times. Our smaller sizes of high speed steel for tool holders are made from scrap ends that break off of wheel, lathe and planer tools, and even the triangular pieces that are cut off the end of wheel lathe tools to give the proper clearance is saved and drawn out into 5-16-in. and ⅜-in. square sizes.

The dope in cellars when engines are brought in for repairs is all saved and sent to oil house to be worked over, and is issued to freight crews to be used in the lubrication of freight car journals. All of the cotton waste used on passenger cars and in the wash yard for wiping cars is saved and sent to the roundhouse to be used again in cleaning the machinery of locomotives. It is then used for firing up purposes.

In the boiler shops, scrap wagon tops, fireboxes, etc., are utilized for frog plates. Our company requires a plate 1 in. x 24 in. x 84 in. under a No. 9½ frog. The cost of this plate is about $10.35, plus freight charges. We get for our scrap boiler plate $11 per gross ton. On this item we make a large saving, taking the cutting up and straightening into consideration. We also utilize scrap boiler plate for transfer plates, and the thin material is used largely for tail shims, fire hoes, eccentric stud keys, center and truck hanger pin keys.

Pieces of burst lengths of air hose are cut and spliced for use on work equipment, tanks, etc., with a considerable saving. For instance, a new air hose costs $.86 and weighs 1¾ lbs. When sold for scrap we get $4.75 per 100 lbs., which

would be about 57 old hose. These 57 hose will make, when cut and spliced, 28 good hose at an additional cost of $.45 for labor and $1.40 for nipples, clamps, etc. This $1.85 added to the scrap value, $4.75, makes $6.60. Twenty-eight new air hose at $.86 each would cost $24.08.

The driving journal compound is taken from the cellars when the engines come in for repairs, or cakes have to be renewed, and is carried to the oil house. There it is pressed into strips and used as a liner beneath the regular cake that has been partially consumed, and this, while it does not result in a direct saving in dollars and cents to the company, reduces the journal grease consumption, and, as future contracts are based on past consumption, it really is a saving to the company. All old files used in the shop that are not worn too bad are recut with a blast of sand and steam. A 16-in. square B file costs $.44, and when recut is restored to about 50 per cent. of its original efficiency.

J. S. Sheafe (Ill. Cen.):—This work on the Illinois Central comes under the test department. Our net saving for the month of June amounted to $11,456. This is all a saving that previous to 1907 went to waste. We have a centrifugal oil machine for reclaiming of oil and waste; also a two-high, home-made reclaiming rolling mill. We reline journal bearings and splice air hose. The latter we use on camp cars, construction cars, locomotives and cabooses, and they give good service. We make brake shoe pins from ¾ in. square and rod iron. I think it is a good idea to hammer down axle iron for follower plates. We reclaim paint scums and slops by boiling down with raw oil in a large kettle and adding red oxide of iron to bring to the proper shade. We reinforce I-beam brake beams, making them 25 per cent. stronger than the same beams when new. We are saving all car roofs and use them for patching outbuildings and in other ways.

G. N. Logan (C. & N. W.):—In connection with the reclaiming of scrap, such supervision is necessary as will insure usable material not finding its way into the scrap pile. As much credit is due to keeping usable material from the scrap pile as in reclaiming scrap material.

R. B. Van Wormer (A. C. L.):—We save the different scrap sheets of the proper thickness and make washers from them. Practically all the bolts that are used in the freight car repair yard at Waycross are obtained from old bolts that are cut off and threaded, and sometimes reheaded.

W. W. Scott (Pere Marquette):—We furnish follower plates for the whole system, forging them from old axles. We are slabbing all our scrap material and making rods out of it; as much of the heavy stuff as we can use is made of the scrap material.

W. G. Reyer (N. C. & St. L.):—We take the grease from the driving-box cellars after they have been dropped. The top scum next to the perforated plate is cut off and placed in a box, which is removed to the oil house. We have a press there and have no trouble about dirt getting in the grease, as we are careful in handling it.

C. M. Newman (A. C. L.):—We cut old flues into three-foot lengths, heat them in an oil furnace and make washers of them on a washer punch. All our tank steel from 1-16 in. to ¼ in. is cut up and made into washers. We split the old arch bars and reduce them for various purposes.

L. A. Reece (C. R. I. & P.):—We used to throw all the grease away that came from the hot boxes. Now a man saves it until he gets 50 lbs. and then takes it to the press and forms it for the grease cup.

Thos. Zinken (C. H. & D.):—We take the dirty grease from the driving boxes, put it in a vat and boil it with steam heat. We cannot sufficiently remelt this over fire heat without burning it, but you can boil it with steam heat for days if necessary. Add a sufficient amount of water to soften the grease and, after softening, add tallow and potash and it will prove as good as new.

Wm. Hall:—In treating the old driving-box grease we use a large can with another can containing the grease inside of it and add a certain amount of water to the grease. A steam jet is then allowed to discharge in the outer can. The chips settle to the bottom and the grease rises to the top. We dump it into wood buckets after it is melted sufficiently and let it cool off, but before doing this we add a little tallow. We sent a sample to the chemist and he said it was practically the same as it was in the original state, and we now use it in our rod cups. Reclaiming asbestos lagging was another problem, and I want to give *Railway Shop Kinks* credit for my first investigation. There was a little machine described in it with a revolving brake wheel. I tried that but was not very successful, owing to the kind of asbestos. It was so hard that the wheel would not cut it very well. I then built a roll of iron, drilled holes into it and put steel pegs in them. We put a pulley on the end of the roll and run it from the line shaft. A box was built around the roll and the asbestos was fed into it by a screw, the teeth on the roll pulling the asbestos through grooves in the frame. It comes out as fine as flour. Then we mix it up with lime and water and apply it again.

THE RELATION OF TESTS TO SHOP EFFICIENCY.

J. S. Sheafe, engineer of tests of the Illinois Central, Chicago, presented a paper on this subject, of which the following is an abstract:

A man cannot do good work if he is constantly wrangling with his associates. Let us go a step further and assume a case where there is no ill feeling, but the minor departments of a railway feel sufficient unto themselves. Rather than the speedy communication possible, where co-operation exists, letters through the various red tape channels are necessary and time is lost. This means burdensome work and wasted stationery. The item of stationery on the Illinois Central amounts to $641,000 a year. It is safe to assume that a large per cent. of this is used unnecessarily.

Let us do what is to be done and do it expeditiously. As an illustration: The steel used for eccentric set screws was giving trouble. It would not machine properly and was delaying the work. Inside of one hour after the gang foreman had called the attention of the general foreman to the difficulty, a request was on the way to the purchasing agent for samples of hex steel suitable for machining and case hardening. From the samples submitted tests were made resulting in the selection of a steel much superior to anything before used. While it is the business of the engineer of tests to locate trouble, it is safe to assume that without co-operation in this case only the merest chance would have brought it to his attention. Had this co-operation been lacking and the matter been reported through the regular channels, it is questionable how much time would have elapsed before the trouble was cleared. In the meantime the general foreman would have been working with a steel unsuited to his needs. The labor item in making these set screws was cut 50 per cent. This does not consider the wear and tear on the tools used in finishing. Whenever a material is wrong no time should be lost in correcting it. As a matter of information a splendid process of case hardening for set screws is hydrocarbonated bone black packed around the work in a box and heated over night, about 14 hours.

A general foreman has no time to write letters, or worry over matters of faulty material or construction. The output of his shop, in quantity and quality of work, is of vital importance to the railway's operation and means that he is helping the road vastly more by directing his subordinates and generally overseeing each bit of work, than he would be by carrying a worrying load that belongs on other shoulders. He should be relieved of this, and on many roads this is being realized by the management.

There is another phase of the possibilities of co-operation.

Assume that we are to try out some articles, such as drills, taps or tool steel. This work can all be done in the test department and with accurate results, but with wasted energy. The work done in testing should be saved. The general foreman and the engineer of tests, by working together, can make the test practically without cost.

Discussion.—The discussion on this paper related largely to the method of conducting practical tests in the shop, a representative of the test department working in conjunction with the shop foremen.

ELECTION OF OFFICERS.

F. C. Pickard, master mechanic of the Pere Marquette, Saginaw, Mich., was re-elected president by acclamation. The other officers who were elected are: First vice-president, W. W. Scott, shop superintendent, Pere Marquette, Saginaw, Mich.; second vice-president, T. F. Griffin, general foreman, Big-Four, Indianapolis, Ind.; third vice-president, L. A. North, general foreman, Illinois Central, Burnside shops, Chicago; fourth vice-president, W. Smith, roundhouse foreman, Chicago & North Western, Boone, Iowa; secretary-treasurer, William Hall, machine shop foreman, Chicago & North Western, Escanaba, Mich.; chairman of executive committee, W. T. Gale, demonstrator, Chicago & North Western, Chicago, Ill.; members of executive committee, C. L. Dickert, assistant master mechanic, Central of Georgia, Macon, Ga.; J. S. Sheafe, engineer of tests, Illinois Central, Chicago; W. G. Reyer, general foreman locomotive department, Nashville, Chattanooga & St. Louis, Nashville, Tenn.; and G. H. Logan, general foreman, Chicago & North Western, Missouri Valley, Iowa.

OTHER BUSINESS.

A unanimous rising vote of thanks and appreciation for his many years of faithful and efficient service was extended to the retiring secretary, Luther H. Bryan.

The convention adjourned Friday noon in order to take advantage of an invitation extended to the members by W. L. Park, vice-president and general manager of the Illinois Central, to visit the shops at Burnside. A special train was provided and a large party spent a couple of hours at the plant. The features that were most generally commented on were the arrangement of the equipment, as well as the uniformly neat and clean appearance of the shop; the large and workman-like force in spite of the fact that a strike is still supposed to be on; the work of the large press in the boiler shop, which was engaged in pressing out flue sheets; and the extensive equipment for reclaiming scrap material.

With characteristic vigor the president appointed the following committees to report next year:

Maintenance of Superheater Locomotives, P. C. Linck, general foreman, C. & E. I., Danville, Ill., chairman; J. W. Anderson, general foreman, C. & N. W., Boone, Ia.; T. J. Mullin, general foreman, L. E. & W., Lima, Ohio.

Engine House Efficiency, W. Smith, foreman, C. & N. W., Boone, Ia., chairman; Thos. Zinken, general foreman, C. H. & D., Indianapolis, Ind.; W. F. Fowler, engine house foreman, Nor. Pac., Billings, Mont., and H. G. Dimmitt, C. M. & St. P., Minneapolis, Minn.

Shop Schedules, L. A. North, general foreman, Ill. Cen., Chicago, Ill., chairman; Henry Gardner, New York Central & Hudson River, New York; and George C. Bingham, C. & N. W., Winona, Minn.

A committee will also be appointed on Apprenticeship.

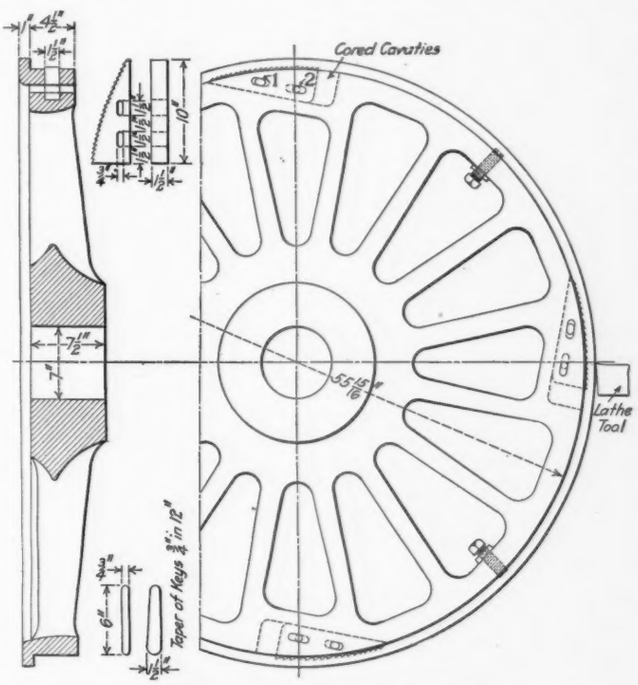
CHICAGO FREIGHT TRAFFIC.—A report of the Chicago Association of Commerce concerning smoke abatement showed that the heaviest traffic entering or leaving Chicago was over the Chicago & Western Indiana, between Forty-seventh and Forty-ninth streets. During one week in January 425,000 tons of freight were moved over this section.

TIRE MANDREL

It is the custom on some roads, whenever tires need turning, to remove them in the engine house, apply a second hand set if it is necessary to get the engine out immediately and to then return the removed tires on a mandrel. In cases where there is no wheel lathe in connection with or near the engine house the tires are shipped to a central shop and there turned in quantities. A supply of tires of various sizes, machined and ready for use, is maintained at the various engine houses.

At the Clinton shops of the Chicago & North Western a mandrel has been designed for holding the tires while being turned, which was proved to be a decided time saver. The custom formerly was to shrink the tires on a temporary mandrel. This method was not only expensive, but required considerable time. At other shops the tires are held by set screws or wedges, but this method will not permit of the heavy cuts frequently necessary.

The mandrel shown in the illustration is clamped to the face-



Mandrel for Turning 56 in. Tires.

plate of the wheel lathe and has a lip against which the face of the tire is held. The four 1 in. set screws are used to hold and center the tire, after which the dogs are forced up by inserting the tapered keys in the keyways, and driving them tight. It will be seen that the wedges are arranged on an incline so that they tend to continually grip tighter as the cut is being taken, and thus to hold the tire securely while being turned, the set screws meanwhile acting as a support midway between the wedges. When the tire is to be removed the tapered keys are taken from slots *1* and placed in slots *2*, which permits them to draw the wedges back to their seats and in this manner release the tire.

Mandrels of sizes to suit different diameters of wheel centers are of course required, and they are frequently made from old driving wheel centers, although it is more satisfactory to have a special pattern for this purpose. Tires can be placed on the mandrel and be ready for turning in less than 15 minutes, which is much less time than would be required for shrinking them on the wheel centers. This mandrel was designed by Charles Markel, foreman of the Chicago & North Western shops, Clinton, Iowa.

CARE OF LOCOMOTIVE BOILER TUBES

Specifications for Tubes, Safe-Ends and Ferrules, and Rules for Renewal, Application and Maintenance of Flues.

BY WALTER R. HEDEMAN.

One of the most important, as well as expensive, items in connection with keeping a locomotive in good working order is the maintenance of the boiler tubes in the highest state of efficiency. To keep down the cost and at the same time maintain the efficiency, it is necessary that methods be standardized for all flue work in the different shops and engine houses. This, of course, must apply to both labor and material. Under the heading of labor it is obvious that instructions must be issued to insure uniform methods and tools being used. As regards material, the best obtainable will be found to be ultimately the cheapest, and only that which conforms to standard specifications should be accepted.

The labor cost of removing, safe-ending, and applying a boiler tube is about 15 cents per tube. This includes all operawith 380 2¼ in. tubes it will amount to $96.90, per locomotive. tions, such as cutting off, welding, expanding, shouldering, testing, scarfing, setting copper ferrules, etc. The material cost will be about as follows: A new safe-end 6 in. long is worth 5.5 cents, a copper ferrule 2.5 cents, the supervision on labor is 2.25 cents per flue, and storehouse and overhead charges .25 cents per flue, making a total cost for labor and material for the renewal of one flue of 25.5 cents. On a modern locomotive

The thickness of copper ferrules used varies with different roads; some foreign roads use a ferrule .049 in. thick; the Pennsylvania Railroad uses .075 in.; the Baltimore & Ohio, .09 in., and the Baldwin Locomotive Works .065 in. A ferrule ½ in. long should be used with 2 in., 2¼ in., and 2½ in. tubes. Specifications for copper ferrules for boiler tubes should include the following: All material should be inspected and tested on its arrival at destination. Ferrules must be made seamless of annealed copper. They must be 99½ per cent. pure copper, free from flaws and other defects. Sizes will be ordered by their outside diameters—all sizes to be cut straight, without beads. Material, to be rejected, should vary more than 1/32 in. either way in length, 1/64 in. either way in aver-

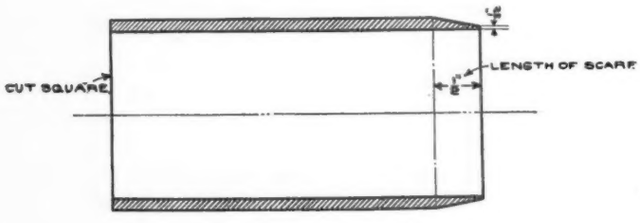


Fig. 1—Detail of Safe-End.

age diameter, .002 in. either way in thickness, and should be brittle, or show defects in working.

In addition to the above tests the right should be reserved to make a repetition of any tests to insure that only material meeting all the requirements set forth in the specification be accepted, and all material not up to any one or all of the requirements should be rejected. Material used for tests, additional to those specified, should be paid for if the entire lot of material is accepted; if the entire lot of material is rejected, the additional test material should not be paid for. Samples representing rejected material should be retained in the test bureau not longer than two weeks from the date of the test. If, at the end of that period, the sellers have not given shipping directions, the material represented will be returned to them at their own risk, they paying the freight both ways, in either case.

Tubes 2 in., 2¼ in., and 2½ in. in diameter should be .125 in. thick, and the safe-ends should be .135 in. thick. The specifications for tubes and safe-ends should include the following: This material should usually be tested and inspected at destination by the railway test bureau. It may, however, be inspected and tested at the manufacturer's works, if the railway so desires, in which case the manufacturer will furnish all the necessary assistance and apparatus for making the inspections

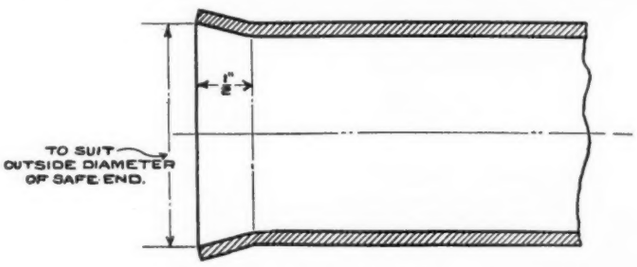


Fig. 2—Flue Flared for Safe-End.

and tests free of cost. In either case the decision of the engineer of tests, as to the acceptance or rejection of the material, shall be final. All tubes and safe-ends should be carefully examined and must have a smooth surface, free from laminations, cracks, blisters, pitting and imperfect welds; they must be free from bends, kinks, etc., and must conform to the size designated in the order; they must be truly circular in section, uniform in thickness throughout, and conform to the thickness and weights specified. All iron and steel locomotive tubes must be lap welded, or seamless; safe-ends must be of seamless steel.

All tubes and safe-ends which are not round, or show a variation in diameter of more than 1/64 in., or whose mean diameter is more than .020 in. of the size ordered, should be rejected. Safe-ends should be ordered in 4 in., 6 in., or 8 in. lengths, to be scarfed at one end on the outside at an angle of about 15 deg. with the center line of the tube, and for a distance of 9/16 in. from the end of the tube, and be not more than 1/32 in. thick at the edge of the scarf, the opposite end to be cut square. All cutting and scarfing must be done with sharp tools to avoid pulling or unnecessarily straining the metal, and must be in a plane at right angles with the center line of the tube. Tubes and safe-ends must be within .010 in. of the normal gage specified. Welded tubes should have an allowance variation of .015 in. at the weld greater than the normal gage.

All tubes and safe-ends showing defects during the process of placing in the boiler should be rejected. All material, before leaving the manufacturer's, must be subjected to a hydrostatic pressure of 1,000 lbs. per sq. in. for seamless tubes, and 750 lbs. per sq. in. for welded tubes. If 20 per cent. or more of the pieces tested fail to meet any of the requirements, the whole shipment will be rejected.

The following rules adopted by one of the largest railways in the United States are the result of years of experience and of the findings of a special committee appointed to investigate the subject. Tubes applied and maintained in accordance with

these rules should have a life of 40,000 miles on superheater engines, and from 55,000 to 60,000 miles on non-superheater engines. The idea was to present the rules in simple language, accompanied by numerous sketches for the information and guidance of the shop men.

RULES FOR RENEWAL, APPLICATION AND MAINTENANCE OF FLUES IN LOCOMOTIVE BOILERS.

Removal of Flues.—When renewing fireboxes, the flues must be cut off inside the inside faces of both the front and back

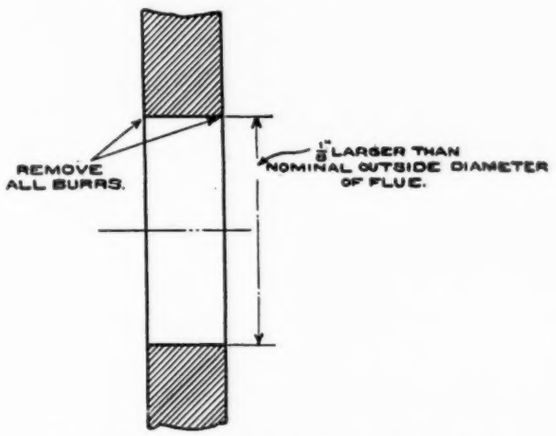


Fig. 3—Preparation of Holes in Front Flue Sheet.

flue sheets, using a pneumatic flue cutting-off machine of approved design. When renewing a partial or complete set of flues, the dry pipe not being removed, the flues must be cut off at the front end, preferably with a pneumatic flue cutting-off machine, and the beads at the back flue sheet should be cut off with a thin flat chisel, and the flues be backed out through their own holes in the front flue sheet, if possible. If not, through a flue hole enlarged ⅛ in. in diameter, located near the center of the front flue sheet.

Safe-Ends.—Safe-ends must be .135 in. thick, in lengths of 4 in., 6 in., and 8 in., of seamless steel tubing, and in accordance with the specifications. One end of the safe-end must be

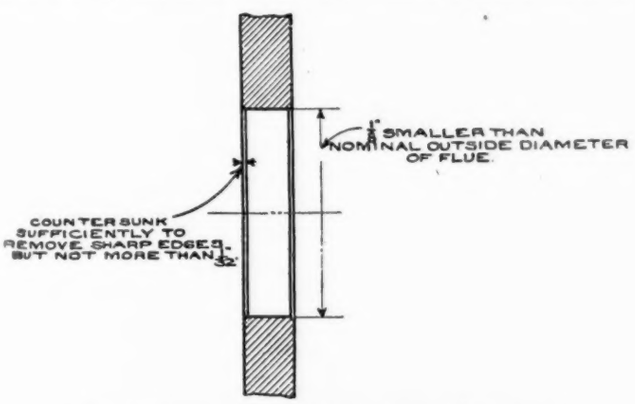


Fig. 4—Preparation of Holes in Back Flue Sheet.

scarfed for a distance of ½ in., being tapered to 1/32 in. in thickness at the end of the scarfing and cut square on the opposite end by the manufacturer, as per Fig. 1. A 4 in. safe-end must be used on all new flues, and when these flues require repairs a second 4 in. safe-end should be applied. The next time they require repairs the safe-end portion may be cut off and longer safe-ends, 6 in. or 8 in. should be used in their places, the object being to reduce the number of welds in the flues.

Preparing Flues.—The firebox end of the flues should be heated and enlarged. Fig. 2 for the entrance of the scarfed safe-end, this being done by ramming on a standard tapered horn. The safe-end should be placed in the end of the flue end, both should be heated to a white heat, drawn out quickly and be welded on a flue welding machine, care being taken to see that the weld is smoothly made. Not more than six welds should show in any one flue. When this point has been reached, the flues may be used again by cutting off the welded portion and applying new safe-ends and using in boilers requiring shorter flues. This may be continued as long as the body portion remains strong enough for use. New flues should be pur-

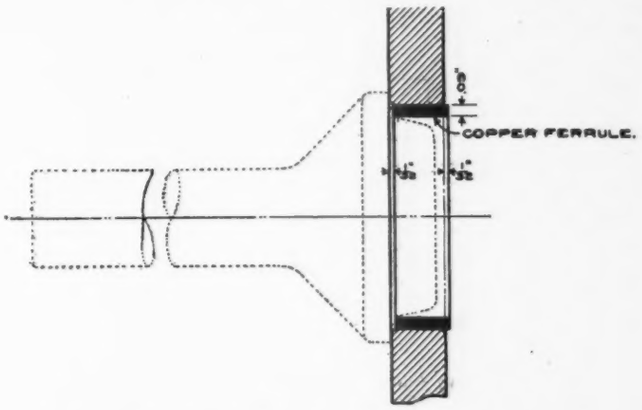


Fig. 5—Setting of Copper Ferrule in Back Flue Sheet.

chased and used whenever possible in the boilers requiring the longest flues.

When measuring over the tube sheets to find the necessary length of the flues, a sufficient number of measurements should be taken to insure getting them of an average length. They should be 7/16 in. longer than the distance over the tube sheets, 3/16 in. of this to be at the firebox end and ¼ in. at the smokebox end. The flues must be cut accurately to the lengths furnished by the boiler maker foreman.

In purchasing new flues it must be kept in mind that a 4 in. safe-end is to be applied, and flues should be purchased 3 in. shorter than the actual distance over the tube sheets. Before

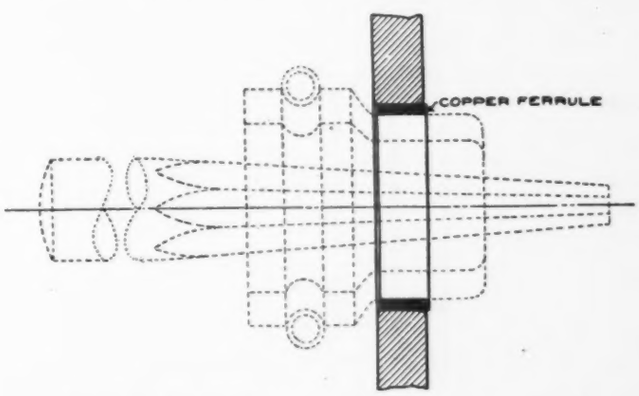


Fig. 6—Tightening Copper Ferrule in Back Flue Sheet.

placing the flues in boilers, care must be taken to see that the ends are perfectly clean and smooth, all burrs and scale being removed, preferably by filing.

Front Flue Sheets.—The smokebox end of the flues should be expanded to a size 1/32 in. less in diameter than the hole in the front flue sheet; all new front flue sheets must have flue holes ⅛ in. larger than the nominal outside diameter of the flue (Fig. 3) to permit quick removal of the flue.

Back Flue Sheets.—The holes in the new back flue sheets must be drilled to a size ⅛ in. smaller than the nominal outside diameter of the flue, and both the inside and the outside edges

of the hole through the sheet should be countersunk sufficient to remove the sharp edges, but not more than 1/32 in., as shown in Fig. 4. When the flue holes become 1/32 in. out of round, they must be reamed with a straight reamer. Copper ferrules must be used only on the firebox end of the flue.

Setting of Copper Ferrules.—The outside diameter of the ferrule should be of a size to tightly fit the hole in the back flue sheet, being set in position by the ferrule setting tool shown in Fig. 5. The shoulder on the tool must seat against the face of the flue sheet to insure the ferrule being properly located 1/32

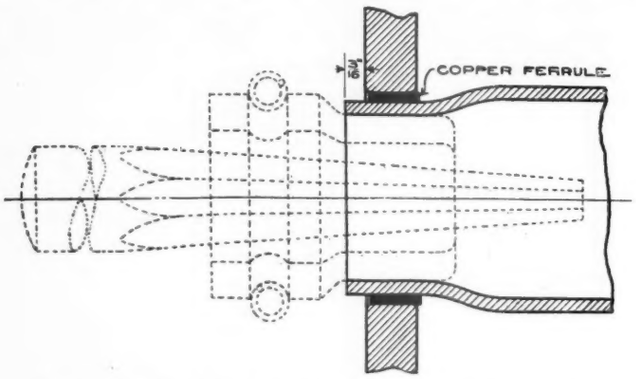


Fig. 7—Tightening Flues in Back Flue Sheet With Straight Sectional Expander.

in. inside of the flue sheet face; after this the ferrule must be tightened in the hole by using the straight sectional expander shown in Fig. 6. When placing the flue in the boiler particular care should be taken to avoid injuring or displacing the copper ferrules.

Setting Flues (Back End).—The flues must be tightened in the back flue sheet with a straight sectional expander, as shown in Fig. 7, after which, they must be flared, using a standard flaring tool, Fig. 8, and then expanded with standard sectional expander, as shown in Fig. 9. A long stroke riveting hammer must be used with each of the above tools, the expander pin or mandrel to be driven into the expander until the flue is solid

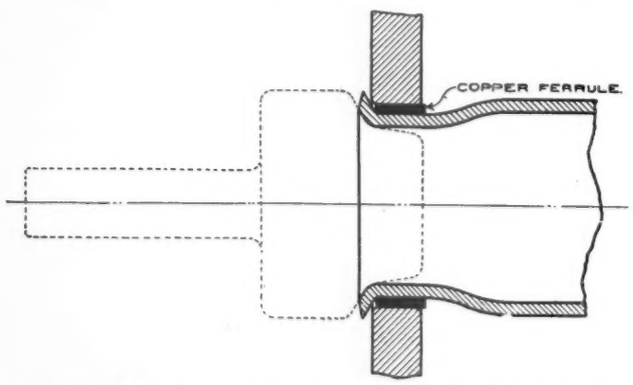


Fig. 8—Flaring End of Flue at Firebox Sheet With Standard Flaring Tool.

against the sheet, then slacked off and the expander turned slightly in the flue and driven in again; this should be done at least three times, or until the flue is properly set and evenly expanded all the way around.

The flues should be beaded as shown in Fig. 10, using standard beading tools. In using a short stroke riveting hammer, care should be taken to see that nothing enters between the bead and the flue sheet. The expanding, flaring, and beading should be done along the lines indicated in Fig. 11, from *A* to *A*, *B* to *B*, *C* to *C*, and *D* to *D*, after which, work should begin at the center of the sheet and work around in a circle until the outer flues are finished.

For flue maintenance in engine houses, the straight sectional expander, Fig. 7, and beading tool only should be used.

Maintaining Standard Tools.—All beading tools must be checked at least once every 30 days by the boiler maker foreman, or some person designated by the master mechanic, to see that they conform accurately to the standard gages. Beading tools not conforming to the gages should be sent to the main shop of each division for repairs, and after being made standard to gage, must be returned to the point from which they were received. Beading tools must not be repaired at any outlying points. After the tools have been checked, a report must

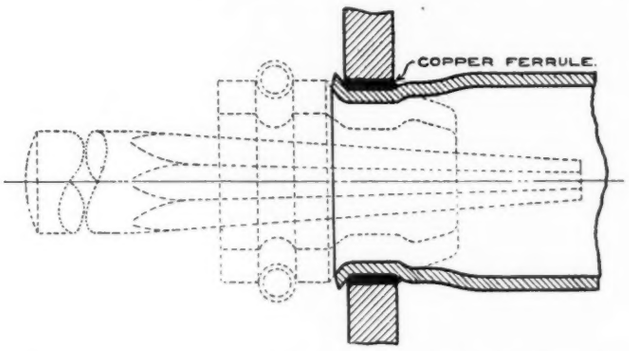


Fig. 9—Standard Sectional Expander for Prossering Flues in Firebox Flue Sheet.

be made to the master mechanic showing their condition, where inspected, and the number of tools returned for repairs.

Sectional Expanders.—Sectional expanders should be cut into eight segments for all tools, except those for superheater flues, and the standard tapered pin or mandrel used with the expanders should have eight sides. The expanders must be maintained by the same method of inspection and checking with gages as the beading tools.

Standard Gages.—Standard gages for beading tools, mandrels and expanders should be available by making application to the mechanical engineer.

Setting Flues (Front End).—Flues in the front flue sheet

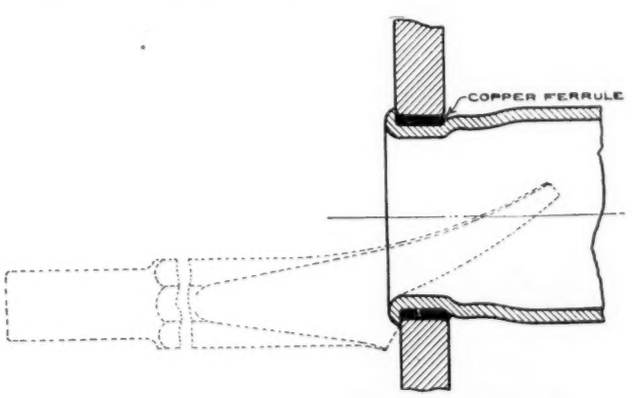


Fig. 10—Beading Flues in Firebox Flue Sheet.

should be tightened, using an approved design of roller tube expander as shown in Fig. 12. No flues should be beaded at the front end.

Care of Flues in Engine Houses.—When flues are reported leaking and the boiler is under pressure, use a straight sectional expander, as shown in Fig. 7, and expand a sufficient number of flues to insure a tight job. Beading tools should be used only when necessary to set the bead back against the flue sheet.

If the entire set of flues is to be worked over, it should be done when the boiler is empty after being washed, and when the sheets are cooled off. The firebox ends of the flues must first be cleaned out thoroughly, and the standard sectional ex-

pander, Fig. 9, should be used for tightening the flues, and the standard beading tools should be used to set the beads tightly against the flue sheet, if necessary. The firebox ends of the flues in service must be expanded with the standard sectional expander, Fig. 9, at intervals of not over 15 days; this being regulated by the service. Flue leaks in the firebox must be stopped by the sectional expander, and not with a roller expander or beading tool. Roller expanders should be used only for tightening the flues in the front flue sheet. The proper height of the beads on the flues must be maintained by using

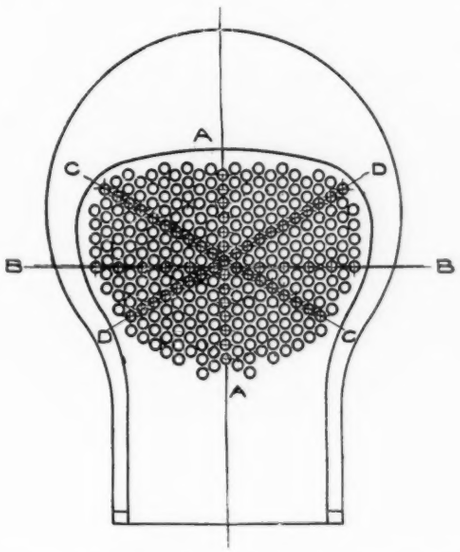


Fig. 11—Order of Working in Setting Tubes in Back Flue Sheet.

only standard beading tools for both new and maintenance work.

Building Fires.—In building new fires a slow one should be started, with the blower turned on just enough to produce sufficient draft to ignite the fuel. The furnace doors should be kept closed and the steam pressure should not be forced. After 100 lbs. steam pressure has been obtained, the blower should be shut off. Care should be taken to see that the fire is well distributed over the grate surface, particularly near the flue

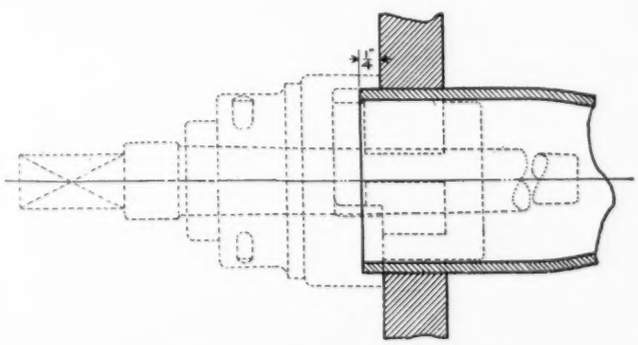


Fig. 12—Front Flue Sheet Roller Expander.

sheet. Whenever possible, warm water should be used for washing out and filling boilers.

Cleaning of Boilers—When the flues are removed from the boiler, it should be thoroughly cleaned and all scale, mud and sediment removed from the shell, firebox, crown sheets and stays, where possible, and a thorough examination made both inside and outside, to detect any cracks in the sheets.

Resetting Flues in Firebox.—When a locomotive arrives at an engine house with the flues leaking so badly at the firebox end that it must be taken out of service, the boiler must be drained, after which the firebox ends of the flues must be reset with the sectional expander.

PREVENTION OF LEAKING FLUES.

In order to reduce the flue leakages to a minimum the following practices must be followed: When fires are being cleaned or drawn the blower should be used only sufficiently to prevent smoke emitting from the fire door.

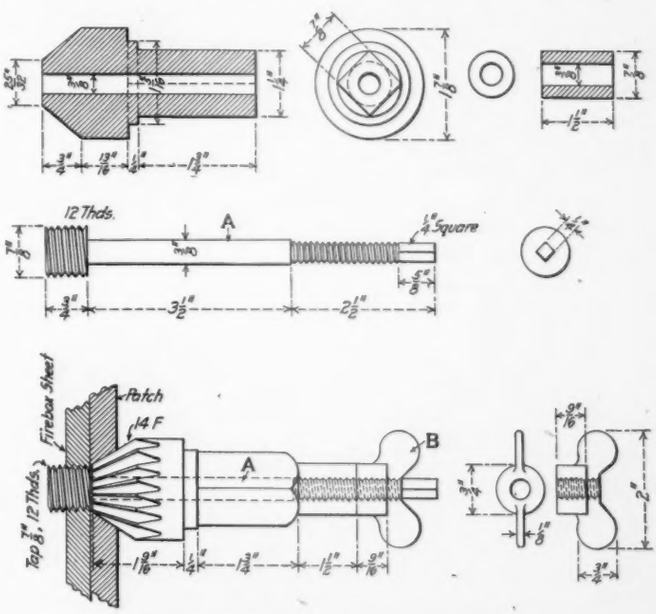
Banking of Fires.—All fires must be banked at the flue sheet except in fireboxes having the front grates bricked off, in which case the fire should be banked over the adjoining grates.

Use of Injectors in Engine Houses and Yards.—Unless absolutely necessary injectors should not be used while the fires are being cleaned, also when no fire is in the fireboxes, and while locomotives are being moved under their own steam in the engine yards without first brightening up the fire.

Care of Flues on the Road.—The boiler should be fed regularly while the engine is using steam, and the supply of water must be so regulated that it will keep the water level in the boiler as uniform as possible. The fire should be kept bright and even at all times when the engine is in service, a good bright fire next to the flue sheet being very essential. The grate shaker should be used at regular intervals, and the clinker hook should be used only when absolutely necessary. Engine crews should be instructed and required to bring engines to the ash pit with light fires, and with sufficient steam pressure and water in the boiler to permit of quick handling and removal or cleaning of fires by hostlers.

COUNTERSINKING REAMERS

The reamer shown in the accompanying illustration is used to countersink holes in boiler patches for the patch bolt head and insures the countersunk hole in the patch being true to the hole in the boiler shell. A pilot bar *A* is screwed into the hole in the boiler shell and provides a true center for the reamer.



Reamer for Countersinking Patch Bolt Holes.

The reamer is turned by an ordinary wrench fitting over the square part of the shank and is forced into the hole by the thumb screw *B*. A few turns of the reamer will make a first class countersunk hole. We are indebted for this information to Charles Markel, foreman of the Chicago & North Western shops at Clinton, Iowa.

FILING AND INDEXING OF TRACINGS

Methods Used on the Erie, as Well as the Practices Followed in Issuing Blue Prints to the Shops.

BY E. G. CHENOWETH,
Mechanical Engineer, Erie Railroad, Meadville, Pa.

Although the question of the proper filing and indexing of tracings has been given a great deal of thought it would take an expert equipment man to locate some of the standard drawings in many drawing rooms. This is not due, perhaps, to not being properly filed, but more to the conditions under which they are filed. The different methods and ideas of different persons in applying titles are found to be a great cause of filing drawings covering the same details under different heads. The selection of proper titles can be accomplished in most cases by appointing one man, whose business it is to assign all titles; this, however, is only temporary and cannot be relied upon to extend over a period of time which would materially better the files as a whole to a very great extent. Another method, which the writer believes preferable in its continual influence to better the files, is to have the card index printed with a standard list and all the details will then be indexed in the same way, as far as the printed index cards cover the file.

It is appreciated, however, that this only covers standard equipment and does not properly care for odd drawings, foreign to the standard equipment. It was found advisable before the titles are printed on the tracings to submit to the chief draftsman, or his assistant, a form filled out giving the drawing number assigned, with the title of the drawing. This form, illustrated in Fig. 1, assists greatly in obtaining uniform and correct titles.

The card index system is believed to be the best method of properly indexing drawings. Four general heads for the filing

ERIE RAILROAD COMPANY.

APPLICATION FORM FOR CARD NUMBERS

ATTACH THIS FORM TO TRACING. LOCATION AND DESCRIPTION TO BE FILLED IN BY DRAFTSMAN. TITLE WILL BE APPROVED AND CARD NUMBER ISSUED BY CHIEF DRAFTSMAN.

CARD NO.	LOCATION	DESCRIPTION

APPROVED:

DRAFTSMAN — CHIEF DRAFTSMAN

Fig. 1—Drawing Titles Must Be Approved When the Card Number Is Issued.

of drawings have been used and found to work out satisfactorily in a railway mechanical department drawing room, i. e., locomotive, car, improvement, tool and machinery.

The locomotive index should include not only the locomotives and tenders, but also all appliances or specialties connected therewith, as well as locomotive cranes. The above classification should be sub-divided into classes and under the classes, should be headings covering the detail parts.

The car index covers all cars, which can be readily subdivided into passenger and freight, and under each would be gasolene, motor and electric cars.

The improvement index should cover yard layouts, buildings, turntables, transfer tables, coal elevators and power plants, including boilers, engines, pumps and generators.

The tool and machinery index comes last, perhaps because what is left over is classified under this head, and it is a fact that in most drafting rooms, where there is a doubt, the drawing is generally classified under tools. This classification should include the tools and machines in the shops, also shafting, hangers and belting, small hand tools and special devices in the machine, boiler and blacksmith shops and all details directly connected therewith.

A rule has been in effect for some years in the office of which the writer is in charge, to make all details for different

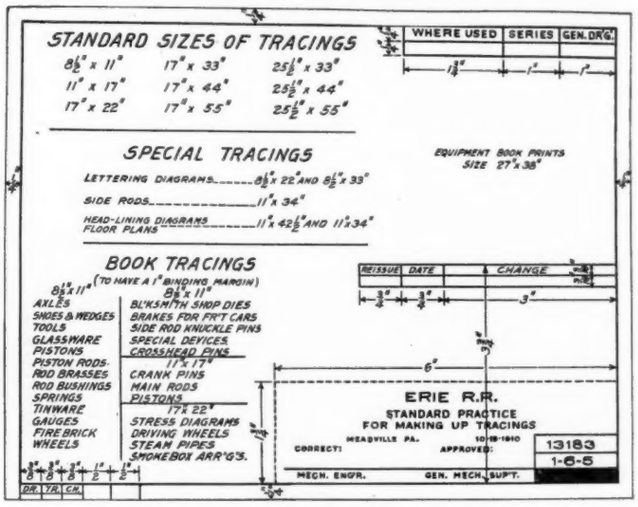


Fig. 2—Standard Instructions for Making Tracings.

classes of equipment on the same size tracings, leaving ample margin at the left hand edge for binding. This is not only very convenient for making up blue print books of certain parts, but it also naturally follows that these details will be filed either in the same section, or in the same size section in the tracing filing case, which assists greatly in locating the tracings.

This can be carried out nicely for drawings covering locomotive and car standard details. Some books of this kind which have been found to be of great assistance to the shops and whose titles appear on covers are: axles for cars and tenders, brake details, crank pins, fire brick, gages, glassware, journal bearings, knuckle pins, pistons, piston rods, rod brasses, shoes and wedges, smith shop dies, special devices, springs, tinware, tools, and car and tender wheels. Other details which can be readily made on standard tracings for books are: side rods, main rods, driving wheels, smokebox arrangements and steam pipes.

Each shop getting one of these books is charged up with it. The cover should be of a loose leaf design so that in case one or more of the prints become obsolete, or are reissued, the correct print can be filed in the cover and the susperseded one removed and destroyed, or returned to the office from which it was issued.

Instructions giving the standard practice for making tracings are issued to the drawing room for the guidance of the drafts-

men. These instructions are embodied in a standard drawing as illustrated in Fig. 2.

All printed notes appearing on tracings should be made of the same kind and size letters. Small capital letters were made standard, inasmuch as it was found that all the draftsmen could more readily make them uniform than any other style of lettering. The type for the titles is also made standard and is printed with a hand printing press.

The reissuing of tracings is in a great many instances not given the thought and attention which it deserves, and sometimes through carelessness or oversight proper reissue notes

ERIE RAILROAD COMPANY

FORM FOR REISSUED CARDS

NOTE—When tracings are reissued, or changed without reissue, one of these forms must be promptly filled out and filed.

Card No. _____ Location _____ Issue _____

Title _____

Change _____

_____

Date _____ 191__ _____ Draftsman

Fig. 3—Form Used in Drawing Room when Tracings are Revised.

are not placed on the tracings. Some notes should merely state what change was made; others should also give the reasons why it was made; while still others should tell what disposition should be made of the material in stock of the original design. It may call for special instructions in regard to finishing or altering the old material, so that it need not be scrapped. While this information or instructions can be given in a circular letter, it must be conceded that a circular letter seldom gets into the shop to the man who uses the blue print, and moreover it is not considered as permanent as a blue print.

When necessary to reissue a tracing it is advisable to have a form, as per Fig. 3, filled out by the draftsman and given

which are readily separated and may have holes punched for filing, if desired, as shown in Fig. 4. On the upper card request is made for specifications, blue prints or standard practice cards and is sent to the mechanical officers' office, from which

★ Form 3212—7,'09—1,000.

ERIE RAILROAD COMPANY

_____ 19__

_____

GEN'L MECH'L SUPT.
MEADVILLE, PA.

Dear Sir:—Will you kindly furnish this office Specifications, Blue Prints, Numbers, Stan. Pract. Cds.

_____

_____

_____

_____

_____

Yours truly,

_____

ERIE RAILROAD COMPANY

Meadville, Pa. _____ *19*__

_____

_____

Dear Sir:—In compliance with your request of _____

I hand you herewith following Specifications, Blue Prints, Numbers, Stan. Pract. Cds.

_____

_____

_____

Kindly acknowledge receipt of prints by returning invoices properly signed and dated.

Yours truly

_____

Gen'l Mech'l Sup't.

Fig. 4—Forms Used in Connection with the Requesting and Supplying of Material from the Mechanical Engineer's Office.

they are issued. In furnishing the prints the lower part of the card is returned with them, making it practically unnecessary to do any letter writing. Attention is directed to the fact that the card is already addressed to the mechanical officer, on

(A) CARD

ISSUED

TO

(B)

INVOICE OF CARD _____

TO _____

ACCOUNT OF _____

DETACH THIS INVOICE
AND KEEP IT ON YOUR FILE FOR REFERENCE.

INSTRUCTIONS:
1st.—Compare the numbers of Card and Print attached with the numbers hereon.
2d.—Detach the "Invoice of Card" and place the same on file in your office for future reference.
3d.—Properly enter the "Invoice of Card" in your records, that you may be prepared to give an account of the same at any time.
4th.—Properly sign and date the "Receipt for Card" and mail the same under cover of envelope to the Mechanical Engineer of the Erie Railroad.
5th.—Keep the Card, bearing numbers as hereon stated, on file and in good order, as same will be referred to, by number, by officials of the Erie Railroad, and same may be recalled by the Mechanical Engineer.
NOTE.—The "Receipt for Card" when signed, dated and returned to the Mechanical Engineer of the Erie Railroad, is placed on file in this office and held as evidence that you have received the Card and are holding and caring for same, as per above instructions.

ERIE RAILROAD CO.
OFFICE OF MECHANICAL ENGINEER, MEADVILLE, PA.

ISSUED _____ _____
MECHANICAL ENGINEER.

★★Form 882—11-11—10M

(C)

RECEIPT FOR CARD _____

TO _____

ACCOUNT OF _____

RETURN THIS RECEIPT
TO THE MECHANICAL ENGINEER OF THE ERIE RAILROAD.

INSTRUCTIONS:
1st.—Compare the numbers of Card and Print attached with the numbers hereon.
2d.—Detach the "Invoice of Card" and place the same on file in your office for future reference.
3d.—Properly enter the "Invoice of Card" in your records, that you may be prepared to give an account of the same at any time.
4th.—Properly sign and date the "Receipt for Card" and mail the same under cover of envelope to the Mechanical Engineer of the Erie Railroad.
5th.—Keep the Card, bearing numbers as hereon stated, on file and in good order, as same will be referred to, by number, by officials of the Erie Railroad, and same may be recalled by the Mechanical Engineer.
NOTE.—This "Receipt for Card," when signed, dated and returned to the Mechanical Engineer of the Erie Railroad, is placed on file in this office and held as evidence that you have received the Card and are holding and caring for same, as per above instructions.

ERIE RAILROAD CO.
OFFICE OF MECHANICAL ENGINEER, MEADVILLE, PA.

ISSUED _____ _____
MECHANICAL ENGINEER.

This Card, bearing numbers as hereon stated, has been received and will be taken care of as per instructions.

DATE:

Fig. 5—Cards Used for Keeping Track of Blue Prints, etc., Issued to the Shops.

to the chief draftsman, who in turn holds it until blue prints from the revised tracing are sent out and the old prints destroyed.

Forms used in requesting and sending out blue prints have also been developed and have been found to work very successfully. There forms are made in the shape of two filing cards which the request is made, and therefore the card need not be sent in an envelope.

Several systems are in vogue by means of which a proper check can be made against the shops to ascertain if certain prints and issues have been received. In keeping check on blue prints sent out, invoice cards as shown in Fig. 5 have been found to

work successfully. The card is self explanatory and, therefore need not be described in detail. The small stub end of card marked *A* is detached and held in the office issuing the prints until the part of the card marked *C* is returned properly signed; it is then destroyed, as it has performed its function. The part marked *B* is retained for file by the shop officer who received the blue print. The part of the card marked *C*, when returned properly signed and dated, is filed numerically in a drawer set aside for the particular shop or station.

MALLET FOR YARD SERVICE

The Baldwin Locomotive Works has recently completed for the St. Louis, Iron Mountain & Southern, a locomotive of the 2-8-8-2 type, which will be used in hump yard service. This is an interesting application of the Mallet type to special service conditions, which in the present case requires a locomotive capable of developing large tractive effort at slow speeds for comparatively short periods of time. When using steam the engine will usually operate at long cut-offs, and the large amount of weight carried on the driving wheels can thus be utilized to the best advantage. The tractive effort developed, when operating compound, is 94,500 lbs.

The locomotive has a separable boiler, with a feedwater heater in the front section. The feedwater enters the heater on the bottom center line and leaves it on the top center, thus circulating through the entire depth of the heater. The rear, or evaporating section of the boiler, contains a Schmidt superheater, with 36 elements. The dome has a diameter of 33 in., and a height of 15¾ in. It is of pressed steel, made in one piece, and its center is 56 in. back of the front tube sheet. The superheater head is placed in an intermediate chamber 66 in. long, located between the evaporating section of the boiler and the feed-water heater. The live steam pipes pass out through the sides of this chamber, and then extend back to the high pressure steam chests. Here the distribution is controlled by inside admission piston valves, 15 in. in diameter and of the built-up type. The valves are set with a lead of 3/16 in.

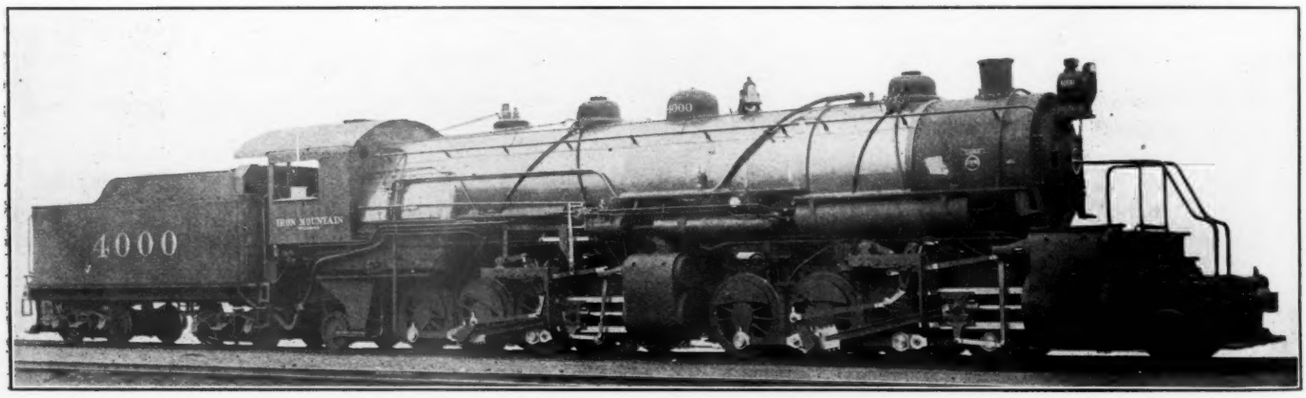
The high pressure exhaust passes out through the back of the cylinder casting and enters a cavity formed in the cylinder saddle. This cavity contains a seat for the ball joint at the back end of the receiver pipe. The center line of the ball joint coincides with the center of the articulated frame connection, thus requiring only one such joint in the pipe. The steam is conveyed direct to the low pressure cylinders without being passed through a reheater. The low pressure distribution is also controlled by 15 in. piston valves.

As this locomotive is intended for service in which frequent starting and stopping are required, a semi-automatic starting valve has been applied, enabling the locomotive to start as a single expansion and subsequently change to compound. The starting valve is placed in a 3-in. pipe connecting the high pressure steam pipes with the receiver pipe. When the throttle valve is first opened, live steam passes through this pipe direct to the low pressure cylinders. As soon as pressure in the receiver pipe builds up, the starting valve closes, cutting off communication between the live steam supply and the low pressure cylinders, and the locomotive then works compound.

One of the illustrations shows this valve in section. The opening at the left connects to the high pressure steam pipe, and the one at the bottom to the receiver pipe. The communication between them is through the medium of eight triangular shaped ports in the 3 in. bushing surrounding one end of the differential piston valve. From the same chamber in which the receiver pipe connection is made is a ⅜ in. passage communicating to the small valve marked *A*. Alongside this is another small valve that closes the passage from the back of the chamber in which the large end of the differential piston operates, to a pipe leading to the cab. A ⅜ in. cross connection is also made from the chamber above the seat of valve *A* to this passage. The pipe leading to the cab carries at its upper end a suitable valve to permit steam pressure to either be admitted or released.

In operation the valve works as follows: As the throttle is opened the live steam passes through the triangular ports to the chamber and the receiver pipe. As this becomes filled and the pressure increases, the valve in the cab being closed against steam pressure, valve *A* is lifted from its seat and the pressure is communicated through the cross passage to the back of the large end of the differential piston. This forces this piston forward against the spring, gradually closing the triangular ports until a balance is obtained between the two pressures. This will be in the same ratio as the areas of the two heads of the differential piston.

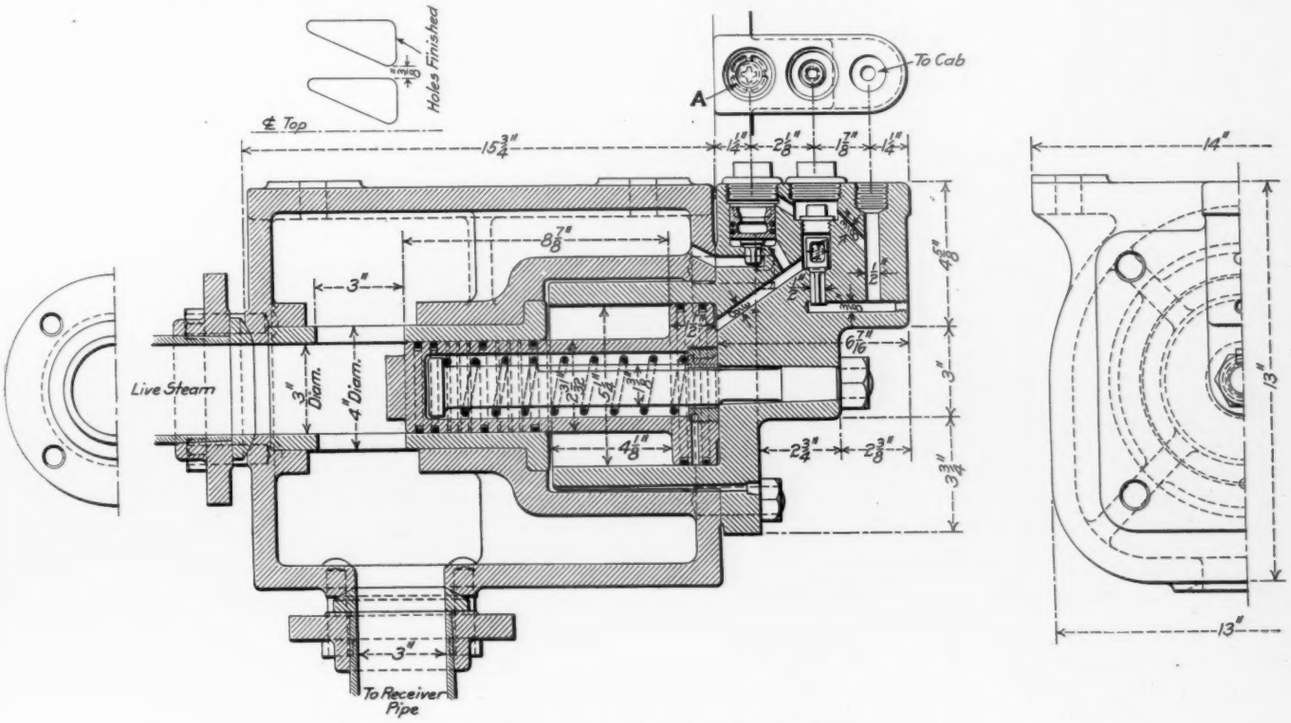
As soon as the high pressure cylinder begins to exhaust, the pressure in the chamber builds up and the valve continues to close until it entirely cuts off the passage and the locomotive is then operating in compound. If it is desired to close the valve before it automatically closes itself, steam pressure is admitted in the cab. This pressure passes through the pipe and lifting the small valve communicates directly to the large piston and forces it forward. At the same time, this pressure through another passage comes on top of valve A and closes it. On the other hand if it is desired to admit live steam to the receiver pipe while the locomotive is in operation the valve in the cab is opened. This relieves all pressure from the top of valve *A*, permitting it to raise and allowing the spring of the differential piston to push it backward, opening the ports until a balance is obtained. When the locomotive is in normal compound operation, pressure is maintained in the pipe leading to the cab.



Superheater Mallet for Hump Yard Service.

The high pressure cylinder saddle is cast steel, made in two pieces. The upper piece is comparatively small and is riveted to the boiler shell while the lower piece is extended back of the cylinders, and to this extension, the rear frames are bolted, while the cylinders are secured directly to the saddle, which thus constitutes part of the frame system. The frames and cylinders are keyed to the saddle by vertical keys, which are arranged in pairs and are driven in parallel keyways with their tapered faces in contact. The arrangement at the low pressure cylinders is generally similar, except that the saddle is made in one piece and carries no superimposed weight.

There are three bearers on the front frames of this locomotive. Normally, the entire weight is transferred through the rear bearer, as the middle bearer has ¼ in. clearance between the upper and lower sections, and the front bearer 1 in. clearance. The middle bearer carries the centering spring, and is placed under the feed-water heater. The upper casting is riveted to the boiler shell. In the case of the front and back



Baldwin Semi-Automatic Starting Valve for Compound Locomotives.

bearers, which are placed under the forward and intermediate smoke boxes respectively, the upper castings are bolted in place. The casting for the back bearer has a spark ejector passage cored in it, so that the smokebox may be readily cleaned of the cinders.

The tender is built with a cast steel frame, and has a tank of 8,000 gals. capacity. The general dimensions, weights and ratios of the locomotive are given in the following table:

General Data.

Gage	4 ft. 8½ in.
Service	Yard
Fuel	Bit. coal
Tractive effort	94,500 lbs.
Weight in working order	435,000 lbs.
Weight on drivers	395,000 lbs.
Weight on leading truck	20,000 lbs.
Weight on trailing truck	20 000 lbs.
Weight of engine and tender in working order	590,000 lbs.
Wheel base, driving	15 ft.
Wheel base, total	56 ft. 7 in.
Wheel base, engine and tender	85 ft. 2¼ in.

Ratios.

Weight on drivers ÷ tractive effort	4.17
Total weight ÷ tractive effort	4.60
Tractive effort × diam. drivers ÷ equivalent heating surface*	885.00
Total equivalent heating surface* ÷ grate area	70.00
Firebox heating surface ÷ total equivalent heating surface*, per cent.	4.31
Weight on drivers ÷ total equivalent heating surface*	67.50
Total weight ÷ total equivalent heating surface*	74.10
Volume equivalent simple cylinders, cu. ft.	29.30
Total equivalent heating surface* ÷ vol. cylinders	200.00
Grate area ÷ vol. cylinders	2.87

Cylinders.

Kind	Compound
Diameter and stroke	26 & 40 x 32 in.

Valves.

Kind	Piston
Diameter	15 in.
Lead	3/16 in.

Wheels.

Driving, diameter over tires	55 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11 x 12 in.
Driving journals, others, diameter and length	10 x 12 in.
Engine truck wheels, diameter	30 in.
Engine truck, journals	6 x 10 in.
Trailing truck wheels, diameter	30 in.
Trailing truck, journals	6 x 10 in.

Boiler.

Style	Straight
Working pressure	200 lbs.
Outside diameter of first ring	84 in.
Firebox, length and width	126 x 96 in.
Firebox plates, thickness	3/8 & 5/16 in.
Firebox, water space	5 in.
Tubes, number and outside diameter	260—2¼ in.
Tubes, thickness	.125 in.
Flues, number and diameter	36—5½ in.
Flues, thickness	No. 9, W. G.
Tubes, length	21 ft.
Heating surface, tubes	4,281 sq. ft.
Heating surface, firebox	252 sq. ft.
Heating surface, total	4,533 sq. ft.
Heating surface, feed water heater	1,230 sq. ft.
Superheater heating surface	890 sq. ft.
Grate area	84 sq. ft.

Tender.

Wheels, diameter	33 in.
Journals, diameter and length	5½ x 10 in.
Water capacity	8,000 gals.
Coal capacity	14 tons

*Equivalent heating surface equals 4,533 + (1.5 × 890) = 5,868 sq. ft.

NEW JERSEY SHIP CANAL.—A contract has been let for the survey of the route of the proposed ship canal across the state of New Jersey from the Delaware river, at Bordentown, to Raritan bay, at South Amboy. An expenditure of $500,000 has been granted by the legislature of New Jersey to purchase the right-of-way, with the expectation that the federal government will dig the canal.

RAILWAY TOOL FOREMEN'S ASSOCIATION

Papers on Milling Cutters and Reamers; Standardization of Steel for Small Tools; Care of Shop Tools; Checking Systems and Electric Furnaces Formed the Basis of Discussion at the Fourth Annual Convention.

President E. J. McKernan, tool supervisor of the Santa Fe, called the fourth annual convention of the American Railway Tool Foremen's Association to order at the Hotel Sherman, Chicago, Ill., on July 9, 1912, about fifty members being present. After prayer by Rev. O. M. Canard of the Normal Park Presbyterian Church, Robert Quayle, superintendent of motive power of the Chicago & North Western, delivered the opening address.

MR. QUAYLE'S ADDRESS.

Mr. Quayle, in commenting on the motto of the association—Higher Efficiency in Railway Tool Service—said in part: Today the efficient man, who is also an executive, is the one who knows what Tom, Jack and Harry are doing. If he does not know that, he is not efficient. The word efficiency not only applies to tools, but in a larger and more comprehensive sense it also applies to men. We talk about shop efficiency, but we are not talking very much about man efficiency, and after all, it is the man that moves the tools. It is the brain of the man that conceives the idea to make the tools. It is the need of the tool that has come into man's brain, and then the man works out the ideas in his head to accomplish what he is looking for. The man is higher than the tool that he makes. We sometimes give credit to the tools, but back of the machine there is the brain and the man who fitted, and adjusted, and changed, and perfected it. How seldom we give credit to the man. It is the thing that we see before us to which we give the credit, and the man often is forgotten.

If you have men working for you and they do something worth while, or something better today than they did yesterday, a word of encouragement makes them bigger and better men tomorrow, and your chances are enhanced because of that kindly word of encouragement. He grows and you grow because he does. You profit by the work he does.

You sometimes think that in this day and generation opportunities have gone by. Get that out of your heads. Opportunities are more numerous today than they ever were. There is more need of invention today than there ever was. Every new invention creates new thoughts. We get in touch with the bigger things of life, and the larger, more intricate machinery. Let us get familiar with the biggest things on earth in our line and the best things in our line and study them out, and do not think that opportunities have gone by. When you cannot find an opportunity, just make one. You are big enough to make opportunities and have things coming your way.

If this association is good for anything, let it be good for eliminating cost by the standardizing of tools and methods. See that your standards will not only be a standard of the local shop, but for the entire system.

MILLING CUTTERS AND REAMERS.

A. R. Davis (Cent. of Ga., Macon, Ga.) presented the following paper on this subject.:

I will consider the topic from the standpoint of cutting efficiency, and the cost of keeping the tools in working condition. We have all been bound to old tradition as to milling cutters and their formation, giving them many flutes of a given form, either with a 12 flute and 40 deg. cutter for the smaller diameters and 12 flute and 50 deg. for the larger diameters and also using arbors entirely too small for the work. For the past three years I have been gradually decreasing the number of flutes, and increasing the total angle of the fluting cutter, with excellent results. After reading Mr. DeLeeuw's article on Milling Cutters and Their Efficiency, presented before the American Society of Mechanical Engineers last year, I proceeded to follow his recommendations as to the number of flutes and their form with results that have exceeded my expectations.

A section of Mr. DeLeeuw's article on the formation of the flutes and their number is as follows: "The 3½ in. diameter cutters are made with nine and the 4½ in. diameter with ten flutes which correspond to about 1¼ in. spacing; the point of the tooth has a face of one thirty-second of an inch, and the back of the tooth forms an angle of 45 deg. with the radial line.

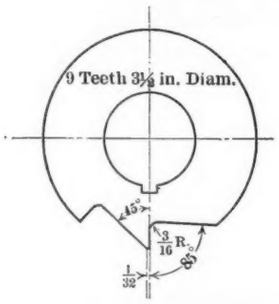


Fig. 1—Formation for Nine Flute Cutter.

The chip space is approximately four times as great as in the usual standard cutter of the present time, and is formed with a 3/16 in. radius at the bottom." These cutters are shown in Figs. 1 and 2.

In using cutters of this form for a year we have not had a single one break in service, and have removed as high as three cubic feet of stock (machine steel) with a 4 in. diameter, 4½ in. face cutter with one grinding. Though not directly connected with the foregoing, attention should be called to the fact that present practice calls for arbors which are too small. In the

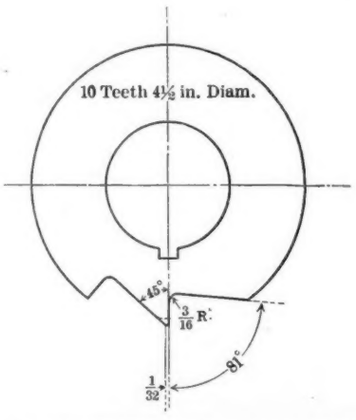


Fig. 2—Formation for Ten Flute Cutter.

cutters mentioned, the 3½ in. is made with 1½ in. and 1¾ in. arbors, the 4½ in. cutter with 1¾ in. and 2 in. arbors.

Since adopting our present standard cutters, I have made a number varying from 3 in. to 6 in. in diameter, and have made the spacing as large as 1⅝ in. on some 6¼ in. diameter cutters, with good results. We mill these cutters with a spiral of 12 deg. angle, and in pairs of rights and lefts to reduce the end thrust on the spindle as much as possible. These cutters are nicked one inch pitch, with a 75 deg. nick, and a 1/16 in. radius

at the bottom. This nick has eccentric relief, giving ample clearance to prevent dragging the stock.

The table below gives the number of teeth for the various diameters of cutters and end mills, and my experience indicates that a spacing of from 1¼ in. to 1½ in. will give the best results.

FOR CUTTERS.

Diam.	Arbor.	Teeth.	Degrees.	Radius.
2½ in.	1 in.	8	90	3/16 in.
3 in. to 3½ in.	1¼ in. to 1½ in.	9	85	3/16 in.
4 in. to 4½ in.	1¾ in. to 2 in.	10	81	3/16 in.
4½ in. to 5 in.	2 in. to 2½ in.	11	78	¼ in.
5 in. to 6 in.	2½ in. to 3 in.	12	75	¼ in.

FOR END MILLS.

Diam.	Teeth.	Degrees.	Radius.
1 in.	4	105	1/16 in.
1¼ in.	5	105	1/16 in.
1½ in.	6	90	⅛ in.
2 in.	8	90	⅛ in.

End mills up to 1⅝ in. require a second cut to relieve the back of the teeth and prevent excessive depth of flute. The back is milled at an angle of 45 deg. to the cutting edge. Figs. 3, 4, 5

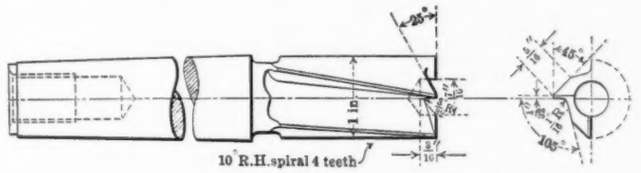


Fig. 3—New Design of End Mill with Four Teeth.

and 6 show the end view of these mills. These cutters will have a greater depth of flute and can be ground oftener and quicker than the old style. The cutter enters the work without excessive chatter and gives a smooth finish. It will not leave revolution marks to as great an extent as a cutter with more flutes. The wide spacing allows more chip room and permits heavier feeds. A ammeter on a motor driven miller shows about 25 to 30 per

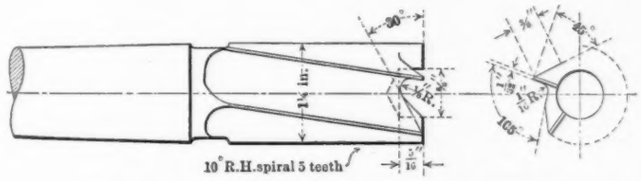


Fig. 4—New Design of End Mill with Five Teeth.

cent. lower power consumption in favor of the coarse flute. The four and five flute end mills cut freely and permit of very coarse feeds, and do not break from choking as does the usual end mill.

The helical cutter gives a fine finish, will not make revolution marks, and does not spring the arbor. The power consumption is very low. On a 60 in. vertical miller used on rod work we

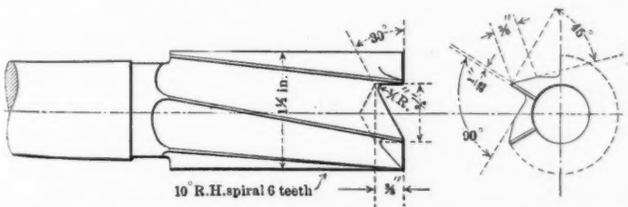


Fig. 5—New Design of End Mill with Six Teeth.

have used a helical cutter, the spiral made to throw the thrust up thus taking the weight of the spindle off the bearings.

The following, from Mr. DeLeeuw's paper, gives a description of the helical cutter: "These cutters consist of a cylinderical body, with two or three screw threads wound around them, the threads being of a section indicated in Fig. 7. The helical is wound around the body with an angle of 69 deg. with the axis. The diameter is 3½ in. and the lead of the helix 4½ in. They are made in two styles, either single, or as interlocking right and left hand cutters. They are given a rake of 15 deg. and clearance of 5 deg. when used for steel, and with a rake of 8 deg. and clearance of 7 deg. when used on cast iron."

The helical cutters I made were given slight changes in the lead and were of diameters from 2½ in. to 4¼ in., but we maintained the same rake and clearance recommended. The results were good.

All of our fluting cutters are given an angle of 12 deg. on one side and the necessary additional angle for the other. They are given an ⅛ in. throw eccentric relief. Cutters 2½ in. in diameter have a 1 in. arbor and 8 teeth for end mills and reamers.

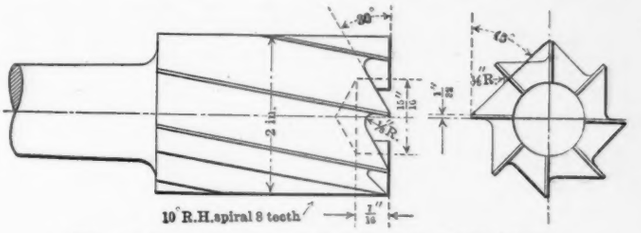


Fig. 6—New Design of End Mill with Eight Teeth.

Cutters 3 in. in diameter have a 1¼ in. arbor and 10 teeth for the milling cutters.

I have not made a thorough test as to the advantage of different angles of spiral in relation to power consumption and finish of work. After trying from 8 deg. to 20 deg. angle of spiral, 12 deg. was selected as the best angle. This may be changed after a more complete test. Each form of cutter is a problem in itself as to diameter, number of flutes and amount of relief.

Reamers are of such a variety of styles and are used for such a variety of work, that I will not deal with any but those most generally used. The 1/16 in. taper per foot hand reamer is the one most used in railway shops, and is also the most abused, running at high speed without oil, and being driven into the work and pulled loose with a jerk and is even run backwards occa-

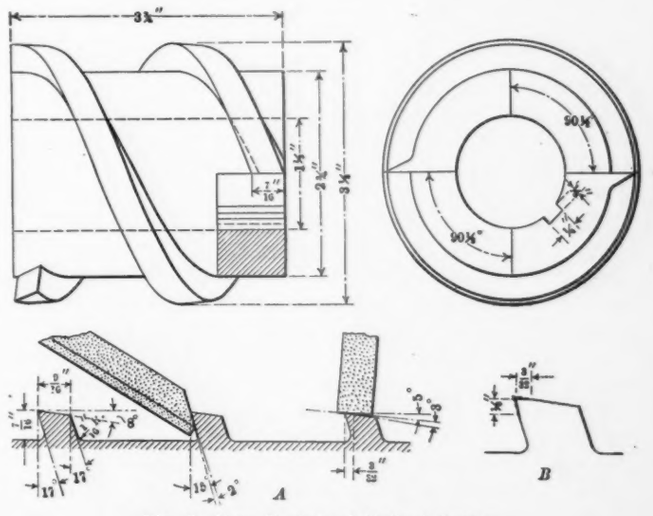


Fig. 7—New Design of Helical Cutter.

sionally. A reamer to give satisfaction must be tough enough to stand this abuse and maintain a cutting edge under the most trying conditions; it must not choke in the flutes and must cut with the minimum power consumption.

With these points in view we have made a number of tests during the past year that included sixteen styles of reamers of four different flute formations. In the preliminary tests we tried a number of different angles of spirals ranging from 5 to 12 deg. and selected 8 deg. as consuming the least power. A list of reamers used in the final test and their form is given in the table. We used three sizes of each form and reamed ⅛ in. from

the holes to get as nearly as possible a uniform load on the motor. The tests were made on machinery steel, part being through a 4½ in. section and part with three 1½ in. plates. We selected 1⅛ in., and 1 5/32 in. and 1-3 1/16 as the average size of bolts used on an engine.

No. Flutes.	Form of Flute.	Power Ratio.
10	Stg. flute	100 per cent.
10	Stg. nicked	98.46 per cent.
10	Spiral 8 deg.	96.63 per cent.
10	Spiral nicked	95.34 per cent.
8	Stg. flute	92.30 per cent.
8	Stg. nicked	86.15 per cent.
8	8 deg. spiral	71.92 per cent.
8	Spiral nicked	70 per cent.
6	Stg. flute	66.92 per cent.
6	Stg. nicked	62.29 per cent.
6	8 deg. spiral	48.84 per cent.
6	Spiral nicked	47.24 per cent.
5	Stg. flute	48 per cent.
5	Stg. nicked	43.96 per cent.
5	8 deg. spiral	43 per cent.
5	Spiral nicked	39.23 per cent.

The strength of all forms of reamers was tested by driving the reamer in a reamed hole ⅜ in. and measuring the load on an 18 in. lever. The result was:

10 flute	Load 500 lbs.	Did not cut.
8 flute	Load 500 lbs.	Did not cut.
6 flute	Load 410 lbs.	Started cutting.
5 flute	Load 380 lbs.	Started cutting.

As to holding a cutting edge, I could not detect any decided advantage of any one form in the test, but since the five and six flute reamer has been used in the shop the amount of grinding on reamers has decreased. I attribute part of this to the fact

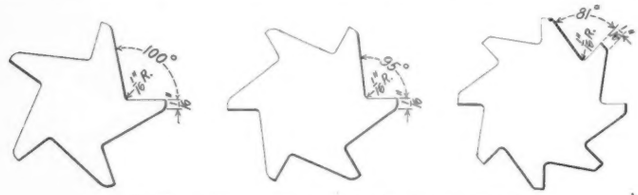


Fig. 8—New Five, Six and Eight Flute Reamers.

that in hand reaming, the reamers are not jerked backwards on account of the reamer pulling easier when driven in the work. End views of the five, six and eight flute reamers are given in Fig. 8. The formation is much stronger than the drawing indicates.

In testing rose reamers, the power required for the different flute formations was much the same as in the taper reamers as in shown below:

8 flute rose reamer	100 per cent.
6 flute rose reamer	63.22 per cent.
3 flute spiral, 30 deg. angle	56.45 per cent.

The ten and eight-flute taper reamers and the eight-flute rose reamers choked in reaming and had to be cleaned frequently. All reamers were run at as high a speed and as coarse a feed as consistant for carbon steel.

The large reamers in use in the railway shops on rod and motion work can be divided into two classes, the shell and the inserted blade. I consider solid reamers over 3 in. diameter obsolete on account of the risk in tempering. We make all rod and motion reamers of 3 in. in diameter and over with inserted blades of high speed steel in a machine steel body, making the blades either ⅜ in. or 7/16 in. thick, nicking them 1 in. pitch. The blades protrude 3/16 in. and have a grove milled at the face of the blade for chip room; the back is milled with a 45 deg. angle. The spacing is from 1¼ in. to 1½ in. This makes a cheap reamer that gives no trouble and is easily renewed when below size. The smaller reamers with sharp tapers are made with 8° deg. angle of spiral left hand, nicked and with taper shanks. The large shell reamer has an advantage over the inserted blade in that it may be cut spiral and reduce the power required.

My experience is that the coarse flute in the milling cutter will give as good a finish as a fine flute cutter, that the coarse flute reamer, except the five straight flute reamer, will give a good finish, and that the coarse flute will cut a shoulder out of a hole faster and thus require less reaming. Also that the spiral and nick are a decided advantage and great power savers.

In tempering cutters and reamers we use the barium chloride furnace for high speed steel and the lead pot for carbon steel. In hardening high speed tools of large sizes we preheat slowly from three to five hours, bringing the heat up to about 1,800 deg. F. and then immerse in the barium and bring the heat up to 2,175 deg. F. and immerse in oil. We then draw in oil to 500 deg. F. and allow them to cool in the air. For carbon reamers we preheat in the muffle furnace to 1,000 deg. F., then immerse in the lead pot bringing the reamer to 1,435 deg. F. (100 to 110 points carbon) dip in water, and draw in oil. to 460 deg. F. Do not draw too fast.

Discussion.—J. A. Shaw (Central of N. J., Elizabethport, N. J.): We are making all milling cutters from Rex A. A. steel. The flutes are milled in 6 in. to 10 in. cutters about 5/8 in. deep and 1⅜ in. pitch with a 40 deg. spiral. They are made in pairs, right and left on one arbor. By doing this the thrust on the spindle is counteracted. We omit the notches for chip breakers on these cutters. In tempering, we heat in a furnace with a very slow heat at the start, then increase it until they are brought to a sweating heat. They are then placed in a cold air blast of about 75 pounds pressure, allowing the blast to play on all parts of the cutting edges at the same time until they are cold. We are having success with this way of tempering and have not lost a single cutter. They are from two to three times as efficient as any cutters we can buy, or make with any other process we have tried.

In reply to a question, Mr. Davis explained that a feed of about .025 in. per revolution was about the maximum in machinery steel. He also stated that the shell reamer had an advantage over the inserted blade, but that he believed in large sizes the inserted blade is the cheaper reamer of the two to manufacture.

Mr. Martin (Big Four, Beech Grove, Ind.): I am strongly in favor of the spiral cutter. We turn our shell. For instance, if the shell of the reamer was 9 in. in diameter and 22 in. long, we mill a slot around the shell and insert square pegs in it. That style of reamer has given us excellent service.

E. F. Eaton (B. & O., Mt. Clare, Baltimore, Md.): I do not agree with the gentleman in regard to the spiral peg cutter. It is a very bad cutter to grind. I have tried several with poor results. The solid inserted blade is better.

Mr. Martin: If the spiral peg cutter has not a uniform lead it will leave marks on the work. After we insert the pegs, we send it to the milling machine and mill a perfect spiral. It is somewhat difficult to grind, but we catch about two teeth at a time and get good results.

Mr. Eaton: I tried to cut them so that the grinder would take two or three teeth at a time. The grinding blade would catch in between the teeth, and I considered it dangerous unless the machine is especially adapted for grinding and the head has a spiral feed. I intended to build a machine for the purpose, but we had such bad luck with the cutters breaking that we gave them up altogether.

G. W. Smith (C. & O., Huntington, W. Va.): We never make the peg cutters, but purchase them. We use an 8 in. cutter on rod work with success. The pegs break out occasionally, but we have not had much trouble about grinding. We have had experience with the solid cutter that was not altogether satisfactory. We purchased the steel and when it came to tempering we followed the instructions given by the manufacturers. They did not show any signs of cracks after the tempering but later cracks developed both ways, lengthwise and around the cutter. The makers of the steel sent an expert to show us how to temper and we had very good success with the cutters he tempered.

Mr. Eaton: We use the inserted cutter for diameters over 6 in. or 7 in. Under that we use the solid cutter.

H. C. Wilson (Southern, Spencer, N. C.): On a pair of 8 in. diameter 18 in. long blade cutters, I used ½ in. x 1 in. Mushet steel, inserted deep and held with copper plugs. They gave good

results. We also made an 8 in. cutter, about 6 in. face, from an old driving axle. It was case hardened with bone at a temperature of about 1,600 deg. for 10 hours and has never been ground. I am getting good results with old axles and piston rod steel. Of course we use coarse teeth and leave plenty of backing. We are milling side rods with the cutter and we are going to make more like it.

Member:—We had some experience along that line that was not satisfactory. It was found that the case hardened soft steel cutters on a large mill would have the teeth driven back in the soft material. We case hardened for about 10 hours.

Mr. Elkart (M. K. & T., Denison, Tex.): About a year ago we had half a dozen engines on which the seats of the throttles had to be changed. The seat was too flat. We decided to make the tool for this work of soft steel and then case-harden it. We made about 8 cutting edges on an 8 in. diameter cutter. It did the job nicely. Of course, there was already a seat established but the angles was changed.

Mr. Sheehan (N. & W., Roanoke, Va.): We purchased some inserted blade cutters. They were 3½ in. wide high speed steel blades and soft steel bodies. Six of these cutters on an arbor as a gang cutter were put to work and we used them only a short time, when it was found that the strain was so great that it imbedded the pin holding the blades in place in the body and we destroyed two sets of cutters inside of a week. I then ordered a number of pieces of side rod steel from the smith shop. In making the slots and blades we kept away from square corners as much as possible. We drew the temper of the blades up to 500 or 600 deg. and obtained good results. The blades were put in with a driven fit and we caulked them in place. We channel many of our rods 1½ in. deep and take a feed of 3 in. a minute. For slabbing work there does not seem to be any limit to their capacity.

Mr. Briggs (D. & H., Carbondale, Pa.): In tempering high speed steel the blacksmith often gets near the melting point. I would like to know what the experience of the members is in connection with the use of so high a temperature. Formerly we ordered our steel for the cutters ⅛ in. large and removed all the scale. Later we ordered high speed Mushet steel annealed to the size of the cutter. We have had some trouble getting good results. I would also like to learn what the experience has been in hardening steel without removing the scale.

Mr. Martin: I think that it depends largely on the brand of steel that you are using. Some high speed steels you must almost melt to get them hard enough to do the work, while other steels will harden at a remarkably low heat. As to using a piece of steel without removing the scale, I do not believe in it. It always pays to remove the outside of any steel that you are using, no matter what kind. Another important matter to consider is the trying to make something that the company can buy cheaper. There are so many things that we can make at a profit that we cannot afford to make anything that can be purchased cheaper. For instance, we started to make Davis boring bar tools and found we could not compete with the factory. We only made one outfit of tools. It is our duty to watch these things closely.

THE STANDARDIZING OF CARBON TOOL STEEL.

Henry Otto (Santa Fe, Topeka, Kan.), chairman of the committee, submitted an individual report from which the following extracts are taken: On account of the many varieties of steel in the market it is rather difficult for tool foremen to secure the proper steels that are needed to meet their requirements. My idea of overcoming this would be to standardize the grades of steel and designate them in a manner that would indicate the per cent. of carbon contained in each. About four classes will meet all the requirements for tools used in railway shops. The four grades would be as follows:

Grade 1	from 0.65 per cent. to 0.75 per cent. carbon.
Grade 2	from 0.75 per cent. to 0.85 per cent. carbon.
Grade 3	from 0.85 per cent. to 0.95 per cent. carbon.
Grade 4	from 0.95 per cent. to 1.05 per cent. carbon.

One of the greatest benefits to be derived from this classification is in the maintenance of the tools, as it will enable us to heat them more accurately for forging and tempering. If the workmen are not familiar with the per cent. of carbon contained in the steel, it is impossible for them to heat the steel with any uniformity, and as a consequence the steel deteriorates. With the grades recommended we should heat and harden the steel at the following temperatures:

For Forgings.

Grade 1	1,750 deg. F.
Grade 2	1,700 deg. F.
Grade 3	1,650 deg. F.
Grade 4	1,600 deg. F.

For Hardening.

Grade 1	1,480 deg. F.
Grade 2	1,475 deg. F.
Grade 3	1,455 deg. F.
Grade 4	1,450 deg. F.

For Annealing.

All grades should be heated from 1,250 to 1,300 deg. F.

The temper of all grades should be drawn to suit the character of the work to be performed.

I would suggest that the first grade of steel be adopted for use in making pick points, wrenches, pinch bars, crowbars, etc. The second grade to make blacksmith tools, boilermaker tools, track tools, hammers, sledges, cold chisels, chisel bars, etc. The third grade to make general machine shop tools, counterbores, milling cutters, punching tools, rivet sets, shear blades, machine drills, etc. The fourth grade to make taps, dies, reamers, small machine shop tools, brass tools, etc.

W. J. Eddy, inspector of tools and machinery, Rock Island Lines, also a member of the committee, recommended that tool steel for making taps and reamers should contain from ninety-five point to 110 point of carbon; punches and dies should contain .85 per cent to 1.00 per cent; rivet snaps should contain .65 per cent. to .80 per cent. He doubted whether tools having shanks used in connection with air hammers should be in the same class as shear blades. Shear blades should contain .90 per cent. to 1.00 per cent. carbon, and rivet snaps should not contain as much carbon.

C. A. Cook, tool room foreman, Chicago, Indianapolis & Louisville, at LaFayette, Ind., another member of the committee, did not think it would be at all practical to use one standard of steel for the making of all tools but did believe it could be covered by two carbon numbers. First, for the reamers, taps, drills, and thread cutting tools, about ninety to one hundred point carbon gives the best results, but for rivet snaps and all tools with shanks to be used in air tools, also punches, dies, and shear blades, where they are subject to the shock, the steel should be of a lower point carbon, say about seventy-five.

A. Sterner, tool room foreman of the Rock Island, at Chicago, also a member of the committee, suggested that the tools be divided in three classes: (1) *Tool room tools*, (2) *Boiler shop tools*, (3) *Blacksmith shop tools*.

The first includes such tools as taps, reamers, drills, milling cutters, threading dies, punches, forming tools, shear blades, etc. The second and third classes include rivet snaps, beading tools, flue cutters, calking tools, prosser expanders, expanding pins, forging dies, etc.

The tools in the first class are all cutting tools, while tools in the second and third are subjected to vibration and heavy pressure strains. For the first class we have been specifying what is termed by the steel makers "Special Grade," giving the purpose for which the bar is to be used. For the second and third classes, we have been ordering the "Extra Grade," except for beading tools and forging dies. Beading tool steel is ordered special and forging dies are made of ordinary steel.

The best system I have seen for identifying the kind of steel is to paint the bars, selecting a different color for each grade and one for annealed steel. A strip of color is painted down the complete length of the bar. When the steel is annealed, two strips are used, one showing the grade and the other that it is

annealed. With this system no matter how small the piece may be, the grade will be known to those accustomed to handling the steel.

Discussion—A. B. Davis: I think 95 point carbon steel is too high for boiler punches. We use about 75 or 80 point and get good results. A boiler punch is a tool that gets considerable shock, and it would nick much quicker if made of high carbon steel. We have four grades of tool steel for use in the tool room, and order to the steel company's specifications. As the steel comes in we paint the bars a different color for every grade and when a workman needs steel for a certain job we tell him to get a white, or blue, or red bar; in that way we have eliminated the possibility of using the wrong steel. We tried to make one kind of steel do, and it was a big mistake. We have a different color for high speed steel. If it is not marked plainly, expensive mistakes will sometimes be made.

August Meitz (Pere Marquette, at Grand Rapids, Mich.): I believe that 90 point carbon is too high for punches. They should be made of as low carbon as is possible to handle. There is not so much danger of breaking the punches by punching through the material, but we find that we break 90 per cent. of the punches by stripping.

J. Martin: Has anyone ever tried to change the construction of the die to prevent the closing up of the material as the punch goes down. A die that is straight on top will close a great deal more than if it crowned on top. I believe if any of you have trouble with breaking the punches as they leave the hole, this will greatly reduce it.

A. M. Roberts: I have been using 35 point carbon vanadium alloy steel for punches for the boiler shop, car and general work, and have had punches good for as many as 30,000 holes, while others break on the third hole. These will be handened at the same time, and made from the same bar. I believe the fault lies in the stripping or dragging unevenly. If it does not strike the stripper section squarely, it will cause a side pull on the punch which will break it. I think the carbon specified by Mr. Otto is all right, but I would rather see it start down at about 50 point carbon. It seems to me that 65 point carbon is too high for some kinds of work.

A. B. Davis: I had a little trouble with rivet snaps. We broke quite a number of those purchased and started making them ourselves. We bought some vanadium bar stock and made the snaps on the turret lathe with fairly good success. We then made some drop dies and drop forged the snaps, and got better results. We did not lower the prices as much as I hoped to, but we did increase the life of the snap. Of late we have been making snaps of tire steel. I was rather skeptical as to results when I first made them, but have to admit that they are a success. We are getting about 10 or 15 per cent. less efficiency with the tire steel than with the vanadium, but they are a good deal cheaper and we are better off on the net cost. However, it is hardly out of the experimental stage yet.

J. H. Arbuckle (G. C. & S. F., Cleburne, Tex.): Through a mistake I once made some punches of high speed steel and did not have very good results; but for dies for boiler shop work high speed steel gives very good service.

E. R. Purchase (Boston & Albany, Springfield, Mass.): I made some high speed steel punches from ¾ in. up and had good results, but on smaller dies they broke off. I think carbon steel is better for the smaller sizes and high speed for larger sizes.

A. M. Roberts: We use quite a bit of high speed steel for punches and our trouble has been that while the steel seems to last fairly well, it becomes rough on the sides and causes the breakage of the punch.

B. Henrikson (Chicago & North Western, Chicago): For a number of years we have dated all tools and stamped the maker of the steel and the percentage of carbon on each. I found it convenient to know how long a tool had been in service and also, when it gets in the scrap, we can pick out the exact kind of steel we want.

O. H. Dallman (Pennsylvania Lines, Chicago): We can use a piece of steel for the purpose for which it was specified by looking it up in the catalog, but I think it would be a good idea for the steel companies to also show the percentage of carbon in their catalog. It would be a great advantage in handling the carbon steel and also in the hardening of self-hardening steel.

TEMPERING OF TOOL STEEL IN AN ELECTRIC FURNACE.

B. Henrikson, tool room foreman of the Chicago & Northwestern at Chicago, presented a paper on this subject, part of which is given below: All metals in the shops are now-a-days being worked at a speed undreamed of in the days of carbon tool steel. Much of this advance is due to the advent of the use of the rarer metals, such as vanadium, nickle, chromium and tungsten, but even their presence would be of no practical importance without the proper heat treatment of the metal after it has been manufactured. This change from the use of the old time carbon steel to the present day special steels is working a revolution in the methods which were formerly in vogue for tempering carbon steels. Temperatures are demanded which cannot be successfully attained in the ordinary forge without danger of altering the composition of the steel.

The best results so far obtained in a furnace requiring fuel have been brought about in the following manner. The tool to be tempered is placed in some sort of a receptacle and all the space around it is filled with finely divided charcoal. Then the receptacle is sealed up, so as to be impervious to gas or air, and is placed in the furnace. The temperature is brought to that required to give the tool the desired degree of hardness (about 2,100 deg. F.), and this temperature is maintained until the heat has had a chance to penetrate entirely through the whole mass. This requires about two hours. The receptacle is then removed from the furnace and the tool taken out and plunged into an oil bath. The charcoal does not adhere to the steel. By this method an excellent job is obtained. An even heating of the steel prevents spring, giving accuracy. By packing in charcoal and sealing, exposure to air, gas or fuel is prevented and consequently the chemical composition is not altered.

The nearest approach to the results obtained in the above manner is obtained by the use of the electric furnace, which itself supplies the place of the sealed receptacle and as it requires no blast or fuel to obtain a high temperature, the danger of altering the chemical composition is obviated. The highest desired temperature can be obtained and by varying the strength of the electric current, any desired degree of heat can be obtained and maintained constant.

There are two distinct types of electric furnaces. One type is so constructed that it forms an open vessel in which is placed a substance which becomes a liquid at the hardening temperatures. The substance generally used consists of barium chloride and potassium chloride mixed in the proper proportion, this proportion depending upon the metal to be hardened and the temperatures desired. For very high temperatures, only pure barium chloride is used. In some shops for temperatures below 700 deg. C. (1,292 deg. F.) pure sodium nitrate is used and sometimes a mixture of sodium nitrate with potassium chloride. The author's experience does not cover the use of nitrates. In practice, it has been found that one objection to the use of this method is that the tongs, used in removing the tools from the bath, decompose and tiny particles of iron collect on the cutting edges and when plunged, these particles become so hard that they can be removed only by grinding. Often it is impossible to grind them off without injuring the tool. Aside from this trouble, very good results are obtained in this furnace. The outer walls of the furnace are never hot, so there is no danger from fire and the cooling bath may be placed close to the

furnace thus reducing to a minimum the time between removing and plunging.

The other type of furnace does not make use of a heating bath, but consists of a box-like structure which may be closed so as to exclude the outside air. The heat is generated by the resistance of carbon resistors located in the side walls of the furnace. The current strength and thus the temperature of the furnace is varied by altering the area of contact of these resistors. The greater the current which is allowed to flow, the higher is the temperature obtained. It is generally found that if the furnace is entirely closed, a reducing action takes place, so a door is provided for the admission of outside air until the action is neutral. Care must be taken in using this furnace, that too much air is not allowed to enter, for then oxidation takes place and the steel will scale.

The electric furnace has a distinct advantage over any kind of a furnace making use of a blast, as in the latter case it is next to impossible to maintain the temperature constant in all parts, and the tool to be hardened will become hotter on one side than on the other and will be sprung out of true. With the electric furnace no draft is required and as a purely soaking action takes place the tool is evenly heated.

Discussion—There was practically no discussion on this paper.

CARE OF SHOP TOOLS.

On account of the illness of J. W. Pike, chairman of the committee on this subject, no report was presented. Several of the members, however, briefly discussed it as follows:

Discussion—A. R. Davis: For beading tools we turn up the shank from the bar stock on the turret lathe and have a die which practically leaves no other machine work to be done. I use lead altogether in hardening. We are using vanadium steel, 7/8-in. octagon. Usually we make a dozen at a time and bring them up to 1,200 or 1,500 deg. in a muffle furnace; they are then heated up to 1,435 deg.—we have brought a few to 1,450—and dipped in water. Afterwards we put them in a basket and draw in oil to 490 deg. They are hardened all over and drawn to an even temper. Our beading tool trouble is a thing of the past. In the last nine months I believe we have made but one order of beading tools for the system. I can not give the actual number of flues each will bead but the first I tempered were used eighty days for all flues in the back shop without injuring them. It is a twenty-three pit shop.

J. Martin: We make beading tools in a forging machine, but previous to sending them to the machine we draw them down on a Bradley hammer. I am not in favor of trying to make a beading tool in one blow, as I think it will injure the steel. Hammering steel properly will refine it. We make them in one blow on the forging machine, after they have been drawn out and shaped up on the hammer. About the number of flues from one dressing of a beading tool. If we get 1,000 we are satisfied. I have tried all tempers, and I would rather stay on the safe side and have a tool to repair than to have it break. The greatest trouble we had with breakage was at the shank. We changed our stock from 7/8 in. to 3/4 in., and gave particular attention to see that bead of the tool was in the center of the stock.

O. H. Dallman: We had a lot of trouble with beading tools in breaking the shanks and tongues, and overcome it by getting an alloy steel. One of these on a thorough test beaded 3,600 flues before the size to the gage was gone. We allow 1/64 in. wear.

A. Meitz: We use 13/16-in steel. We did use 7/8 in. but changed to 13/16 in. and find that it makes the best shank.

Other members reported both 3/4 in. and 13/16-in. octagon steel to be satisfactory for this purpose.

O. H. Dallman: In forming the tools up in one blow, I would like to know if Mr. Davis makes them sideways or endways. Stock 3/4 in. in diameter will not carry enough if you do not upset it.

A. R. Davis: We form them endwise in a die.

C. A. Sheffer (Illinois Central): We tried many different kinds of drills for opening up the holes of rusted staybolts, and even had a number of flat drills made. They worked very well but were expensive. I attempted to obtain some high-speed bar or tool steel about 5/32 in. square, but was not able to get it. A small piece of steel of this size ground down on the four sides to a point, makes a very good drill for opening up these holes, with the exception of staybolts that are riveted over so that the hole is closed. I also took the matter up with one of the companies that makes special drills for tell-tale holes. These drills are made of flat twist high-speed steel, the material used having a concave surface on each side. They made me a number with a flute straight edge, and I believe they are superior to anything in the twist drill line for this purpose.

B. Henrikson: We had trouble in drilling the tell-tale holes, which we make 3/16 in. in diameter. I got up a kink for doing the work which includes an injector that squirts water in the hole. When the machine is started the water blows the chips out. A man can drill 60 or 70 staybolts an hour. In opening up, I find the carbon drill is about as good as any.

E. R. Purchase: I made some staybolt taps with a 45 deg. rose reamer on the end, and find that they make a good hole. You get the hole and the tap follows pretty straight.

Member: I notice the manufacturers are making a four fluted staybolt tap. In our shop we have received them without specifying, and when we put them in use we could not get the bolts to follow the tap. The five fluted tap gives no trouble.

H. Otto: The five fluted taps are the best. You should have a bucket of compound, and when you tap from the outside, use four or five taps in rotation.

J. J. Sheehan: I make a motion that we recommend, as a standard, boiler studs of 3/4-in. taper per foot, 12 thread, the form of the thread to be U. S. standard, and that it receive the endorsement of the Tool Foremen's Association.

The matter was laid over for one year to be disposed of at the next meeting.

CHECKING SYSTEM FOR SMALL TOOLS.

Committee: J. T. Fuhrman (Great Northern, St. Paul, Minn.), Alfred Peterson (Colorado & Southern, Denver, Colo.), G. Mitchell (Erie, Galion, O.), H. E. Blackburn (Erie, Dunmore, Pa.) and J. B. Hastey (Santa Fe, San Bernardino, Cal.).

The committee made the following recommendations:

Have the toolrooms centrally located, well lighted, and equipped with racks large enough to hold a sufficient number of tools to meet the daily requirements. Enough cupboards should be furnished to hold templates, standard gages, and a small amount of tools for stock, also files, punches and dies, taps, drills, expanders and repair parts for pneumatic drills and hammers, etc., to replace broken and worn tools.

Every tool should be stamped with its size or name. Have a rack for drills, one for reamers, one for taps, etc. Place the heavy tools at the bottom, and the light ones on the top shelves.

Keep the tools most in use close to the window. Have a stamped brass plate fastened to the shelf showing the size or number of the tool placed there. The tool room, for its use only, should have checks to signify the tools under repairs, or to be replaced. There should be a tool or a check of some kind in every place where a tool is kept.

All the men have shop numbers and the same number should be used on his tool checks; the man when first employed should give his name and check number to the tool room attendant, who makes a record of it and furnishes six tool checks. The office furnishes the toolroom attendant with a list of all the names and their clock number at the end of every month. The list is hung up over the check board, which holds six checks of each number on the time clock in the shop. If there are any changes made the attendant will change the checks.

When a man gets a tool from the tool room he gives a check

for every tool he receives, and the check is put in the place where the tool is kept.

All tools out on tool checks should be returned to the toolroom every night before the hour of closing. Where tool checks remain in the toolrooms over Sunday, the general foreman should be notified and the men to whom the checks belong should be required to give an explanation of why they did not return the tools. A clearance card properly signed should be presented to the toolroom for tools damaged or broken before the tool check will be returned to the workman. At the close of each week the clearance cards should be given to the general foreman.

No machinist, boilermaker, handyman, or apprentice should be allowed to keep any tools whatever in a private place. Such practice is always bound to end by having a large number of tools locked up out of service.

No tools should be loaned outside of the shop beyond the check system, except by a written order from the superintendent, or his assistant. A record should be kept by the tool foreman of every tool loaned and it should be signed by the man who received the tool. The order is kept as a check and is returned to the office when the tool is returned.

No man should receive his time upon quitting without having a clearance card signed by the toolroom foreman.

Generally speaking boys and helpers are employed as toolroom attendants. The idea is to have the boy get acquainted with the tools. It may be all right for the boy, but it is bad for the tools. It takes some time to get acquainted in a large toolroom, and a boy generally wants a change before he really gets familiar with the tools. The attendant should be a man well acquainted with all tools, and should know when a tool is to be repaired or sharpened, and there should be enough help for giving out tools at rush hours in the morning and evening, and the spare time of the extra men should be used in cleaning shelves and tools.

Discussion—Several members described the systems in use in their shops which, in general, were practically the same as the committee recommended. The use of apprentice boys, however, for passing out tools at the windows is very common. There was also some disagreement with the recommendations of the committee as follows:

J. Martin: It is important to know what it costs to carry tools back and forth. In the case of some small tools that cost 50 or 60 cents, the time wasted after they are carried back and forth several times may amount to more than the tool did in the first place. I think it is almost impossible to insist on the men carrying the tools back to the toolroom each night in a large shop. They would have to stop work much earlier in order to get the tools in. I am in favor of giving the men outfits, especially those that are on special classes of work. Each of these men should have a tool box large enough to hold his outfit. We are mounting these on hand trucks. The stud man has his air motor; he could not work 15 minutes without it and he uses it continually. He has taps that he uses frequently, his air hose and, in fact, everything he needs. The box is numbered and he is furnished with a key to lock it. We have a list of the tools in it and frequently inspect them. I find that a man will take much better care of these tools than if he was dependent on the toolroom for them. The idea may be applied to all classes of work. We have men who do not come to the toolroom once a week. If a machinist has to come to the toolroom, his helper has to wait until he returns. Probably there are three or four at the window when he gets there, and sometimes, after he has waited he does not get what he came for. In a large shop where there are 1,000 or 1,200 men working, you can never pass the checking room that you do not see one or two men, often many more. These men are losing time and it is a dead loss; in some cases it exceeds the first cost of the tool. I do not mean that a man is supplied with everything that he is ever expected to use. He is supplied with the tools he uses mostly. For instance, the stud man—the sizes of studs in a boiler do not have a very wide range and he has a set of the general sizes only. He is supplied with the tools he uses mostly. We have a number of such special tool boxes and I feel that it pays to have them.

A. M. Roberts: This scheme puts too many tools out of use. It would be like making a special engineer for a certain engine and that nobody else could run it. In the shop we have 600 or 700 men; it takes a great many motors, and I think too many tools would be tied up and out of service. We try to keep the motors constantly in service. When they are not in use they are worthless, just the same as a locomotive when it is not running. It is constant service that gives the returns. When a man is through with a motor he immediately returns it to the toolroom, and it is there for somebody else to take out.

C. A. Sheffer: I believe the value of this scheme depends on local conditions, or the distance the toolroom is situated from the work. In some cases an outfit would be a good thing. I would like to know what a standard outfit would include.

E. J. McKernan: We have a standard outfit—it is listed in duplicate on cards. The man who receives the tools has a record, and a copy is left in the toolroom. If he draws more than his required outfit it appears on the card. When he quits he takes his supply to the toolroom and unless he can check off all the tools on the list he will not receive his time.

H. Otto: The outfit given a man depends on what line of work he is doing. A floor man gets three or four files, three chisels, a flat chisel and a monkey wrench; these tools are marked on a card, and he signs it himself. He also gets any extra tools they are marked on the card, and when he quits his tools are returned.

A motion made by A. M. Roberts and seconded by H. Otto, that the association recommend the use of six checks to be carried by the men, was amended by A. R. Davis to read as follows: The American Railway Tool Foremen's Association approves of a checking system that includes the following features: A set of six checks shall be furnished. The man shall carry his checks. Lost checks cannot be replaced without an order from the superintendent or general foreman. Broken or lost tools shall be accounted for to the foreman or general foreman before the checks will be released. A value shall be placed on checks. A man must have a tool clearance before receiving his time. Checks cannot be loaned.

This motion, as amended, was carried.

Honorary Membership—W. H. Bray, former vice-president, president and secretary-treasurer of the association, who has resigned from railway service, was unanimously elected an honorary member.

Election of Officers—The following officers were elected for the next year: President, J. Martin (C. C. C. & St. L., Beech Grove, Ind.); first vice-president, A. M. Roberts (B. & L. E., Greenville, Pa.); second vice-president, August Meitz (Pere Marquette, Grand Rapids, Mich.); third vice-president, M. B. Roderick (Erie, Hornell, N. Y.); secretary-treasurer, A. R. Davis (Cent. of Ga., Macon, Ga.); executive committee, O. H. Dallman, C. A. Shaffer, A. Sterner, J. J. Sheehan and E. R. Purchase.

The report of the secretary-treasurer showed a balance of $60.22 and a total membership of 68.

Water Famine at the Isthmus.—A water famine occurred in parts of the Canal Zone in May, owing to prolonged dry weather. Cristobal was supplied from the Gatun system by loading barges with water, towing them to Cristobal, and pumping the water from them into the mains. West Culebra, Bas Obispo and intervening places were partly supplied from the Chagres River.

REPAIRING DRIVING BOXES*

BY H. WANAMAKER.

The methods of repairing driving boxes outlined below have been found very successful at the Depew, N. Y., shops of the New York Central & Hudson River. After the cellars have been removed and the driving boxes have been taken off the axles in the erecting shop, they are placed in a basket made of 3/16-in. boiler steel, perforated with 1-in. holes in the bottom, which is lifted by a crane and taken to the lye vat. They remain in the

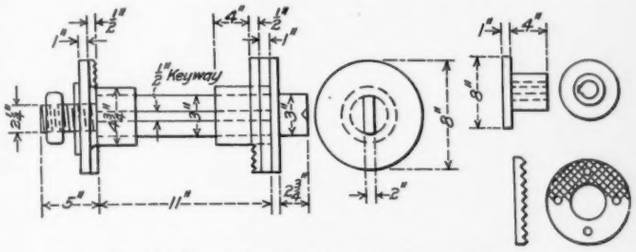


Fig. 1—Chuck for Turning the Crown Brass.

basket while in the vat and, after soaking for about three hours, are lifted out and washed with clean water. They are then delivered to the machine shop. The machinist in charge of driving box work carefully inspects them, and if the brasses are loose in the boxes or are worn below 1 3/8 in. in thickness at the crown, they are removed. In the former case, sheet iron shims are put in the corners and the same brass is again pressed in. If it is too thin at the crown, the brass is melted and used for hub faces or shoe and wedge liners. After a loose brass is shimmed and pressed in place, the plug holes are reamed and new plugs are fitted.

Assuming a case where the brass is to be scrapped, the first operation is to drive out the plugs. After these are removed,

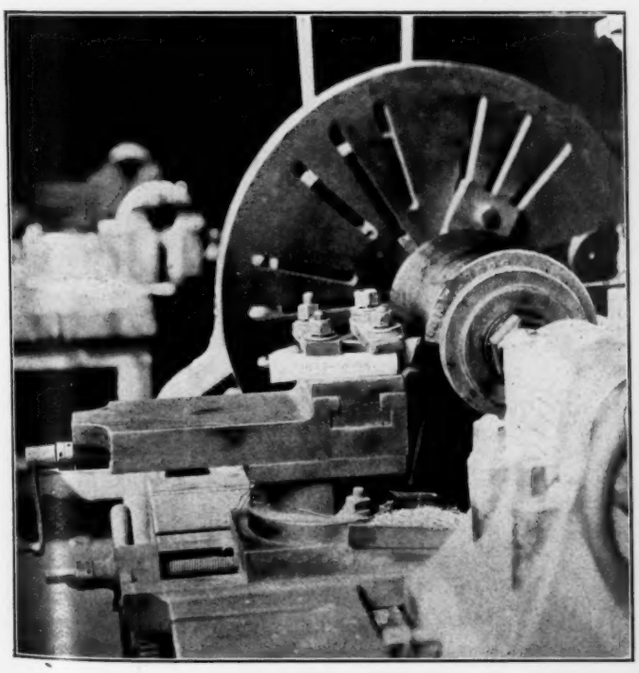


Fig. 2—Turning a New Crown Brass.

the box is placed on a pneumatic press and the brass is forced out. The box is then calipered by the machinist. The new crown brasses are turned on a lathe, being held in the chuck shown in Figs. 1 and 2. After being turned it is placed on a face plate and the edges or ends are carefully laid out. It is then clamped on the table of a shaper and machined to size. The next operation is to mill the grease grooves. This is done on the machine shown in Fig. 3.

After the brass is pressed out the driving box is clamped on

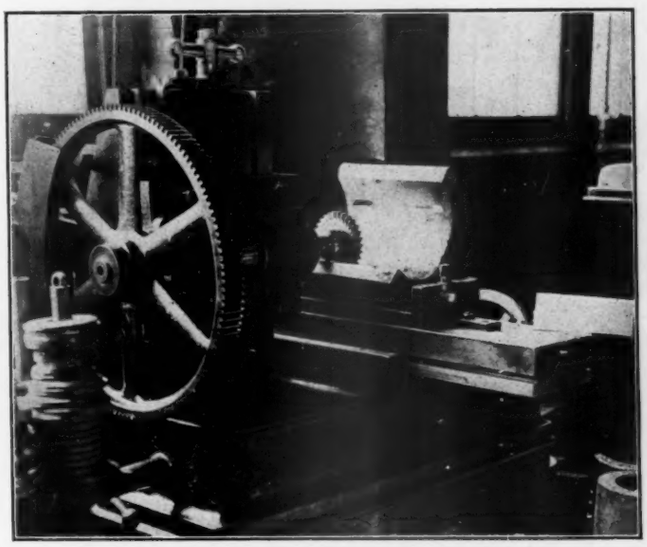


Fig. 3—Milling Grease Grooves in the Crown Brass.

a planer and the brass facing on the shoe and wedge face is removed. It is then taken to a boring mill and the brass hub liner is cut off. The crown brass is then pressed in place on

Fig. 4—Pressing in a Shimed Brass.

*Entered in the shop practice competition which closed May 1, 1912.

the pneumatic press shown in Fig. 4. This press has a 20-in. cylinder, and a pressure of 120 lbs. per sq. in. is used. A swinging jib crane transfers the box to a drill press where the plug

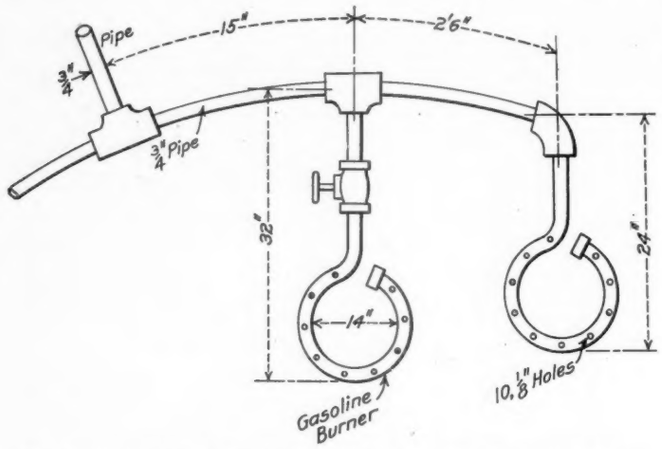


Fig. 5—Apparatus for Preheating When Pouring Brass Hub Faces.

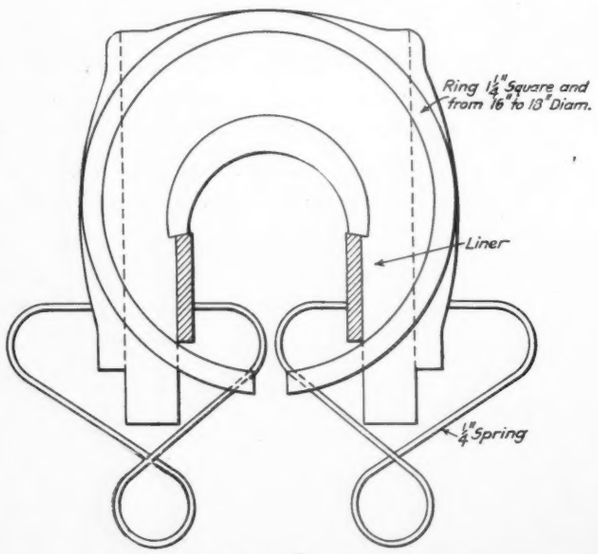


Fig. 6—Mold for Pouring Hub Faces.

holes are drilled and reamed. Tapered brass plugs of the proper length are driven from the inside and riveted.

The box is next transferred to the foundry by a hand truck

Fig. 7—Boxes After Hub Face and Shoe and Wedge Liners Have Been Poured.

and the new brass shoe and wedge liners and hub facing are applied. In preparing the boxes for pouring, four are heated at a time, using the gasolene torch shown in Fig. 5. The boxes are laid in a level position on the floor and this torch is blocked just above the spaces where the hub faces are to be poured. After heating, a mold is applied as shown in Figs. 6 and 7, and the brass mixture, made of 400 lbs. of scrap brass, 50 lbs. of copper, 6 lbs. of lead, 3 lbs. of tin and 10 lbs. of zinc, is poured. After the hub face is cool, a mold is clamped at either

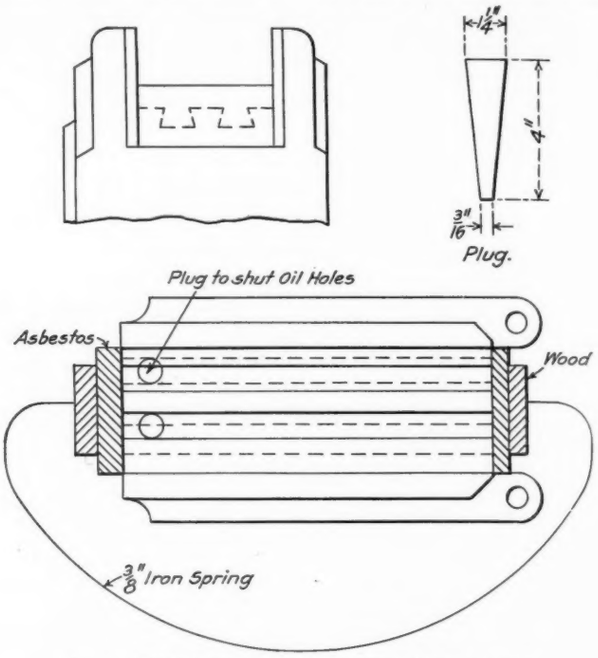


Fig. 8—Molds for Pouring Shoe and Wedge Liners.

end of the shoe and wedge faces as shown in Figs. 7 and 8, and the liners are poured from the same material. In Fig. 7 the method of arranging the plugs for coring the oil holes is clearly shown.

After again being transferred to the machine shop, the box is clamped to the planer as shown in Fig. 9 and the shoe and

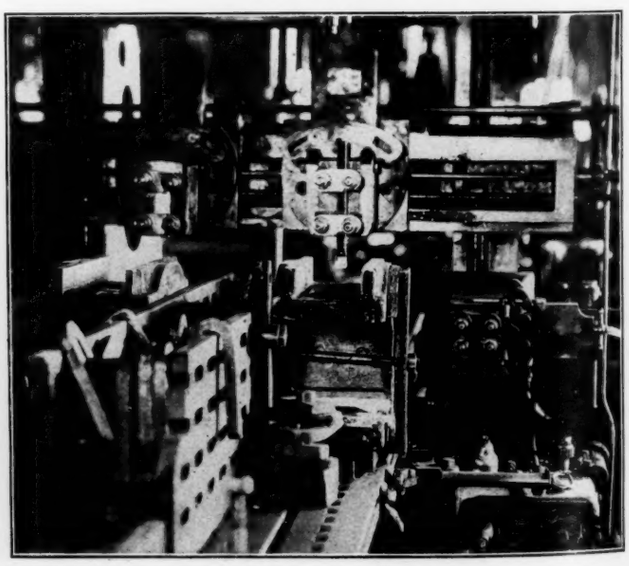


Fig. 9—Boxes Clamped on the Planer.

wedge faces are machined to size, after which it is put on the boring mill and bored for the journal fit. While still on the boring mill, the hub face is machined to the proper thickness. In the erecting shop it is fitted to the axle by scraping and spotting. The oil grooves on the shoe and wedge face are chipped and the cellar is fitted to the box.

In the following table are given the times required for the different operations.

OPERATION.	MACHINE.	TIME PER PIECE.
Cleaning	Lye vat	25 min.
Inspecting		5 min.
Pressing out brass	Pneumatic press	10 min.
Remove hub face	Boring mill	45 min.
Remove shoe and wedge facing	Planer	30 min.
Caliper for brass		1 min.
Turn new brass	Lathe	15 min.
Slot corners of brass	Shaper	10 min.
Mill oil grooves	Milling machine	10 min.
Press in brass	Pneumatic press	15 min.
Drill all oil and plug holes	Drill press	45 min.
Apply plugs	Hand	5 min.
Heat and pour hub face and shoe and wedge liners		12 min.
Plane shoe and wedge fit	Planer	65 min.
Caliper and set boring tool		5 min.
Bore the brass	Vertical boring mill	25 min.
Face hub liner	Vertical boring mill	20 min.
Fit box to axle	Hand	30 min.
Fit and pack cellar	Hand	15 min.

EMERY WHEEL GUARD

BY E. L. DUDLEY,
Baltimore & Ohio, Baltimore Md.

The emery wheel guard illustrated is simple to make and apply, and is effective. Fig. 1 shows a side view of an emery wheel, such as is used to grind small castings. *A* is a cast iron guard, and usually covers more of the back of the wheel than is shown here. *B* is the guard which is to be described. The material used is 1/16 in. glass and 1/8 in. galvanized iron. First cut out the two upper covers and the middle *C* of a piece of 1/16 in. iron, as shown in Fig. 2; also punch the rivet holes in the upper edge. Slit the two lower corners and flange the ends and sides over, as shown in Fig. 3. Solder over the two corners where the iron laps. Two of these parts should be made.

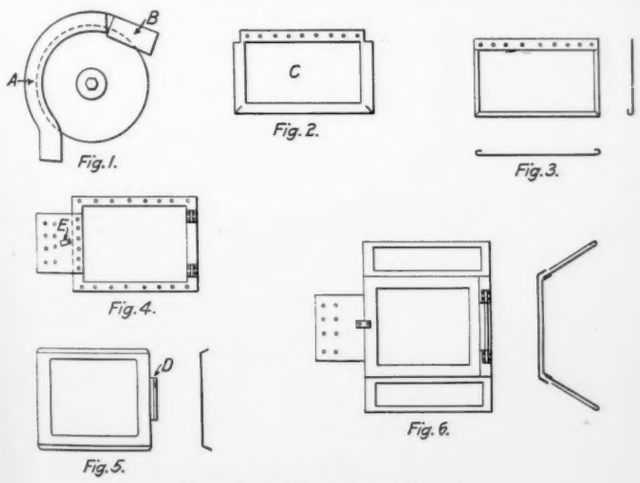


Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6.

Glass Guard for Emery Wheel.

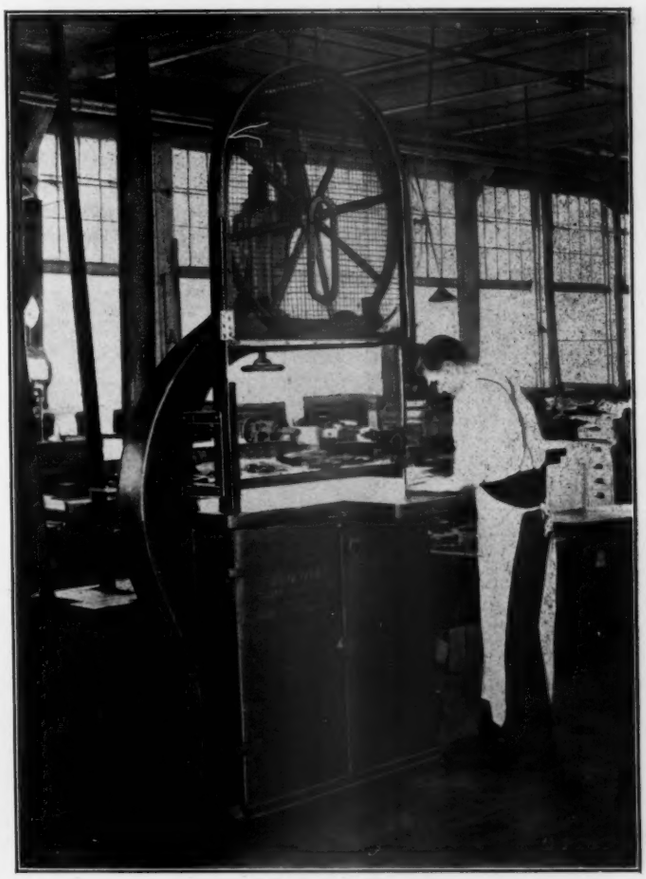
Next cut a piece of galvanized iron, as shown in Fig. 4, and make two hinges out of the same material and rivet on; also rivet a piece of ⅛ in. iron at the left side and punch the holes in this plate and on the edges of the frame. A door of the same material is then made, as shown in Fig. 5, and is fitted on the part shown in Fig. 4. It is held in position by a piece of wire which goes through *D*, and the hinges on Fig. 4. The other edge of the door is held by the button *E*.

The next step is to assemble the guard. Two pieces similar to the one shown in Fig. 3 are riveted to Fig. 4 on the top and bottom sides. The piece extending to the left in Fig. 4 is riveted to cast iron guard *A*, shown in Fig. 1.

The guard assembled is shown in Fig. 6. Having cut the glass the proper sizes, the lid or door is lifted, and the glass is applied to the sides and the top. The lid laps over the sides, so that the glass for the sides cannot be applied without raising the lid. The advantage of such a guard is that all flying particles are stopped, thus eliminating the necessity of wearing goggles, and at the same time the work can be plainly seen. The glass can be easily taken out and cleaned, and when broken can be readily renewed. The guard is easily made, and may be applied to larger wheels, if desired.

BAND SAW SAFEGUARDS

Possibilities of serious accidents with band saws are very great, even though used with considerable care and skill. A saw which it is believed is safeguarded sufficiently to prevent any possible personal injury to the operator is shown in the accompanying illustration. The entire lower part of the machine is enclosed in a steel casing, and the upper wheel is encased with a wire netting and steel guard. The use of netting permits a circulation of air to keep the saw cool. It is hinged to the casing so that it may be swung aside and the saw removed when desired. A hollow split tube covers the saw from the upper wheel nearly to the work table, so that there is no danger to the operator when he leans forward to watch his lines. Similarly, at the back where the saw ascends it is shielded in such a way that the elbow cannot be caught when large circular shapes are being worked in curves around the blade. It will be noticed that the use of



Safeguards on a Band Saw.

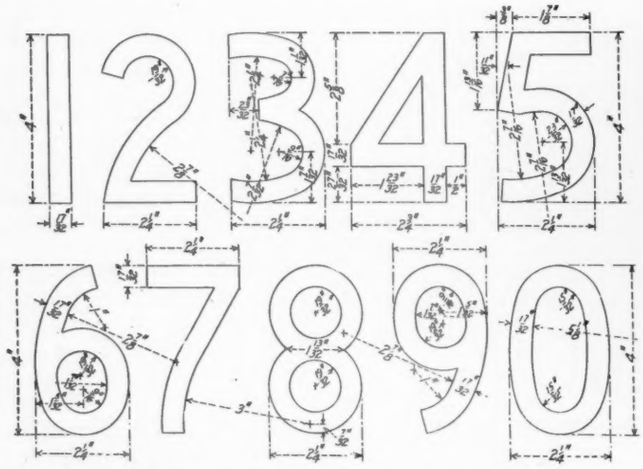
netting for enclosing the upper wheel also has the advantage of not obstructing the light. There is a slot provided in the netting to permit the adjustment of the bearing of the wheel, if necessary. This guard bears the endorsement of the Industrial Safety Association, to whom we are indebted for the photograph.

ENGLISH TRAFFIC.—On account of the recent strikes in England the majority of railways did not start on their regular summer schedules until the middle of July.

NEW HEADLIGHT AND CAR NUMBERS

The accompanying drawing shows the design of lettering which has been adopted for headlights on the western lines of the Canadian Pacific. They are also used on time cards, and it is expected that they will be put on engine cabs, and possibly later on box cars.

They were designed by George Bury, vice-president, with the idea of making them so distinct that it would be impossible to mistake them. In many designs of figures in common use the "3", the "6" and the "8" may often be mistaken for one another. This is largely because the loops on the 3's and 6's are long, and it will be noted that this feature particularly has been eliminated in the accompanying figures. The difference between the "5" and the "6" has also been noticeably increased.

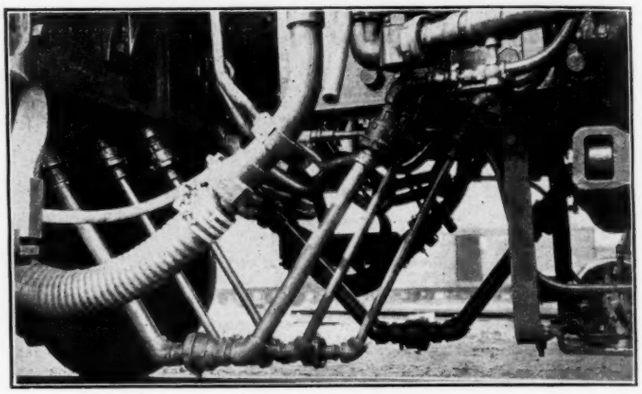


Headlight Numbers Used on the Canadian Pacific.

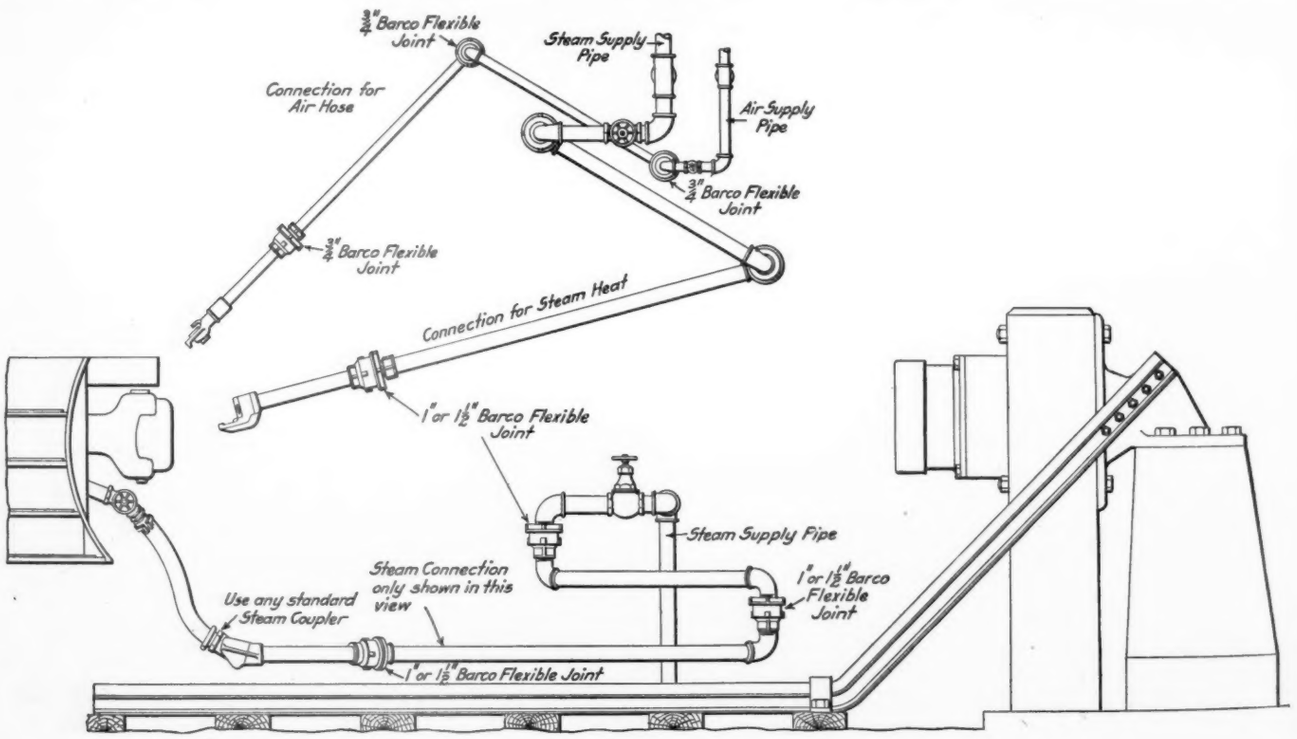
Figures on locomotives and cars have to be read hurriedly in all kinds of light, and the accidents sometimes due to misreading engine numbers and the trouble resulting from misreading car numbers make it worth while to try to improve the legibility of the figures.

BARCO FLEXIBLE JOINTS.

Experience with the Barco flexible joint shows that it is well adapted to a number of the requirements of railway service where flexible connections are required, and it is now extensively used as a substitute for rubber hose, especially for the pipe connections between the engine and tender. This joint consists of three metallic parts and two composition gaskets which surround the ball and prevent it from coming in contact with other metallic parts; that is, the cap and casing. The vulcanized gaskets provide a firm resisting seat somewhat softer than the metal ball but hard enough to keep their shape without disintegration.



Barco Flexible Joints on Pipes Between Engine and Tender; Chicago & North Western.


¾" Barco Flexible Joint
Steam Supply Pipe
Connection for Air Hose
Air Supply Pipe
¾" Barco Flexible Joint
¾" Barco Flexible Joint
Connection for Steam Heat
1" or 1½" Barco Flexible Joint
Steam Supply Pipe
Steam Connection only shown in this view
1" or 1½" Barco Flexible Joint
Use any standard Steam Coupler
1" or 1½" Barco Flexible Joint

Application of Barco Flexible Joints to Steam Heat and Air Connections at Terminals.

The success of this joint is largely due to the peculiar qualities of the composition gasket, as it has sufficient softness to

secure a tight joint and has self-lubricating qualities which insure easy movement with minimum wear. These gaskets are reversible, and thus insure a double wearing surface, and are easily renewable at a small cost. The outer ring of the coupling is split and provided with a set screw so that it becomes adjustable, and slight wear can be taken up in this way.

While many of the Barco joints are made of brass, it is found that when made of a good quality of malleable iron they are entirely satisfactory; they are sufficiently strong and rustproof, and considerably cheaper than when made of brass. This reduction in the cost of the joint makes it possible to use it in places where the higher cost of brass joints might be prohibitive.

The illustrations show some of the recent applications of this joint. The photographic view shows its use between engine and tender on locomotives recently placed in service on the Chicago & North Western. The large pipe connection is for air to the main train pipe. One of the smaller ones is to the tender brakes and the other for the signal line. The drawing shows the application of the joint for steam heat and air at terminal stations. Here there are several swivel joints with radius pipes which allow considerable flexibility and adjustment. A piping system of this kind is also economical for ash pits, where steam hose is used up very rapidly; it also has a useful application for engine houses, where a steam connection is used for blowing the fire. These flexible joints are made by The Barco Brass and Joint Company, Chicago.

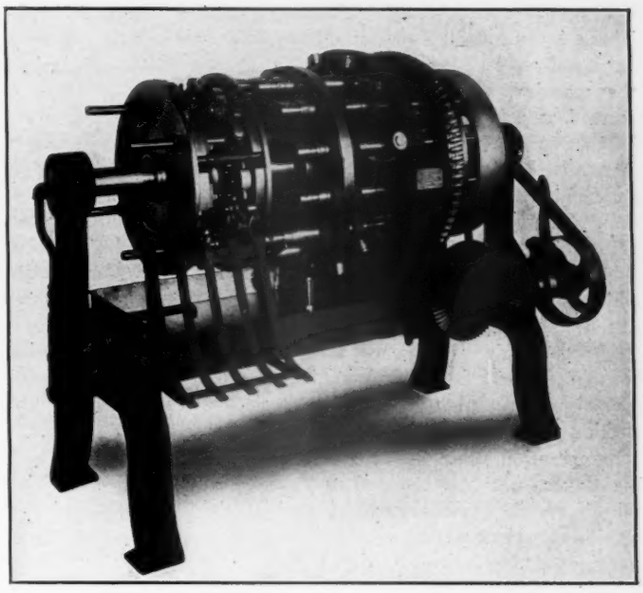
COLD METAL SAW AS A ROTARY PLANER

In shops where a considerable amount of structural material, such as I-beams and channels for tender and car underframes, have to be cut to length, an efficient cold metal saw has been found useful. In most railway shops, however, this machine will not be kept at work all the time, and by the arrangement shown in the illustration its efficiency may be decidedly increased by also using it as a rotary planing machine.

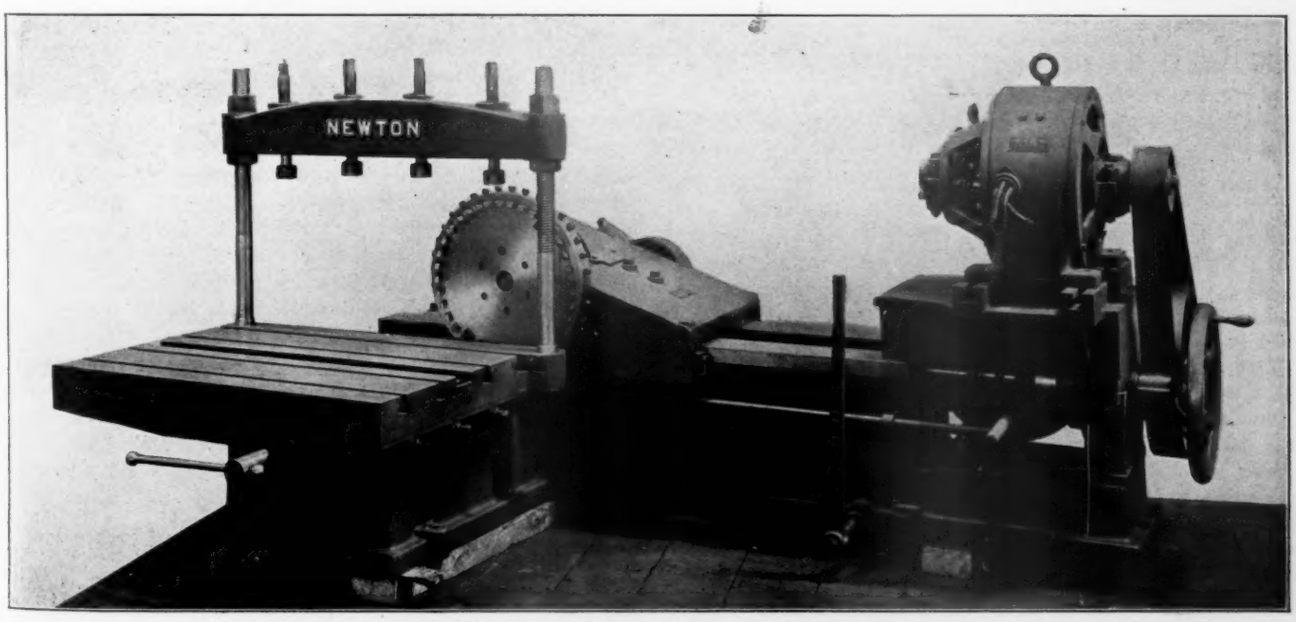
It is readily apparent that a machine that is suited to use inserted saw teeth will be equally suited for work where the teeth are on the side of the holder instead of on the circumference. Therefore, by simply substituting a rotary cutter head for the saw blade, a cold metal saw of this type becomes an efficient rotary planing machine or surface miller. It is then available for facing the ends of large steel castings and similar work. The capacity of the machine shown in the illustration, which is built by the Newton Machine Tool Works, Philadelphia, Pa., is indicated by the fact that it is capable of removing 1¼ cu. in. of metal per horsepower per minute when sawing with a kerf only 9/16 in. in width. It is also capable of cutting off a 15-in. I-beam in two minutes.

STAYBOLT DRILLING MACHINE

Drilling tell-tale holes in staybolts has become a formidable operation in many of the larger shops. While it is sometimes performed after the staybolts are in place in the boiler, it seems to be considered better practice to drill them before their application. To drill each one separately is expensive unless it can be performed at the same time some other operation on the bolt is under way. This plan is generally not feasible, and a semi-automatic machine has been designed which will permit



Semi-Automatic Machine for Drilling Staybolts.



Newton Cold Metal Saw Used as a Rotary Planer.

rapid work with the attention of only an apprentice boy or helper after the machine is once adjusted.

This machine has been designed by the Richmond Staybolt Drilling Machine Manufacturing Company, of Richmond, Va., and carries 12 spindles for drilling. These spindles will drill any depth of hole up to 2⅞ in., and can be arranged to use drills between 3/16 in. and ¼ in. in diameter. The chucks for holding the drills are carried on one-inch steel spindles that are driven by steel gears which are three inches in diameter with a one-inch face. These 12 small gears mesh with a large 12-in. cast iron gear secured to a shaft driven by a pulley or motor. All of these gears are enclosed in a casing that forms part of the framework which carries the drill spindles and chucks. The outside of this casing is a worm gear, and the whole casing is slowly revolved when in operation. On the drill spindles are sleeves or bushings carrying the drill heads. There is an offset shoulder on these sleeves which carries a hardened steel roller. A cast iron ring, fastened to the bed of the machine, encircles the group of spindles. This ring is formed as a cam on its face and the rollers on the sleeve are held in contact with it by two springs. As the nest of spindles is revolved this cam gives the proper feed to the drills and is arranged to withdraw the drill at the completion of a revolution. There are also two offsets or reliefs which allow the drills to be withdrawn to clear cuttings at intermediate points.

Mounted on the same shaft with the nest of gears is a cage which carries the apparatus for gripping the bolts. Each bolt has a separate grip composed of a malleable casting with a steel case-hardened jaw which is adjustable to take any size bolt from 15/16 in. to 1¼ in. in diameter. These grips are opened and closed automatically by a cam, and the jaws are cushioned to prevent rigidness.

In operation, the staybolt is simply dropped in its grip, and is then automatically clamped as the cage slowly revolves. The drill head then comes forward, and at the completion of the revolution the staybolt is drilled, the drill is withdrawn, the clamp opens, and the bolt drops clear of the machine without further attention.

A rotary force pump takes the drilling fluid from a retainer under the machine and forces it through a passage in the main shaft which is connected to a cavity in the die plate hub, from which it is conveyed by a small pipe to a discharge at each drill. There is a small air pipe arranged to clear any shavings or chips from the grips immediately after the bolt is released.

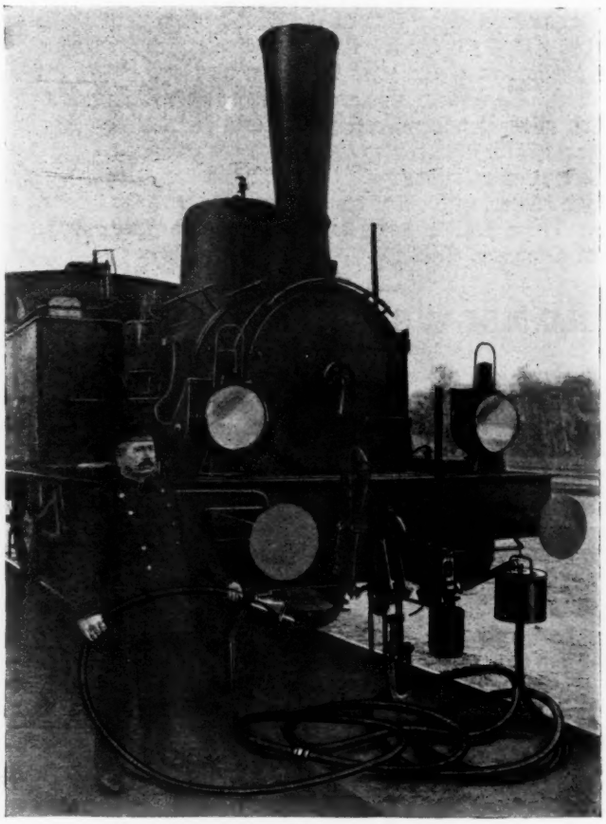
AN ASPIRATOR FOR COACH CLEANING

BY FRANCIS P. MANN.*

A new apparatus for cleaning railway cars is being furnished to a number of railways on the Continent by Julius Pintsch of Berlin. It operates in much the same manner as the usual vacuum cleaners as regards the operation of cleaning, but is a small portable device connected to the steam heating pipe on a locomotive. It is arranged to be quickly applied and removed, and can be easily stored either aboard the train or at the coach yard or station.

This apparatus is known as a steam aspirator designed on the Koster system and creates a suction through the long hose by means of a steam ejector. In the accompanying illustration it is shown applied to the front end of a small locomotive. The ejector, which is arranged to be readily fitted to the steam hose connection, has a condensing pot below it for collecting the condensed steam. The larger tank to the right is the dust collecting vessel and to the bottom of this is connected about 50 ft. of hose with the suction head for cleaning at the end. Before starting the cleaning, the dust collector is partially filled with water and when the steam is turned on a partial vacuum is formed and the dust-laden air passing through the hose is cleaned by the water in the collector and reaches the aspirator in a purified condition. This air partially condenses the steam and the tank retains the condensation. Such steam as is not condensed is exhausted through the vertical pipe from the top of this tank.

After the operation has been carried on for some time the dust collecting tank becomes filled with a thin mud, and a discharge plug is provided by which it can be easily cleaned and fresh water again introduced. All parts of the apparatus are so arranged as to be easily taken apart and cleaned. The suction head is made in different shapes, according to the kind of cleaning to be done, and the best results are found to be obtained when the hose from the suction head, for a distance of about 15 ft., is of a smaller cross section than the remainder. Some of the suction heads are provided with small pipes so arranged that the incoming air acts as a jet and stirs up the dust and dirt in upholstery, etc. It is stated by the manufacturers that although neither the condensing pot nor the collector are absolutely necessary for the success of the apparatus, they have been applied and their use is recommended for sanitary reasons.



Aspirator for Coach Cleaning.

*12 Boulevard Arago, Paris.

British Coal Exports.—In the five months ending May 31, this year, the export of coal from the United Kingdom was 20,416,679 tons, as compared with 26,255,066 tons and 23,898,792 tons in the corresponding periods of 1911 and 1910 respectively. The following were the principal shipments in the first five months of the last three years:

Country.	1912. Tons.	1911. Tons.	1910. Tons.
Sweden	1,030,269	1,353,327	1,337,047
Germany	2,379,271	3,489,983	3,347,541
France	3,415,107	4,473,896	3,890,391
Spain	1,258,864	1,384,012	1,121,132
Italy	3,159,856	3,750,576	3,464,850
Egypt	997,948	1,288,357	1,067,012
Argentina	1,082,730	1,433,502	1,172,544

GENERAL NEWS SECTION

At a recent meeting of the Board of Pensions of the Rock Island Lines over $550, monthly pensions, were awarded.

Safety committees have been organized by General Manager Henry Miller, of the Wabash, which will have duties similar to those of the committees on other roads.

The sinking of a coal mine at Dunmore, Pa., on the night of June 25 damaged the building and contents of the Erie repair shops to the extent of $16,500. No person was in the building when the settling occurred.

E. L. Copeland, secretary and treasurer of the Atchison, Topeka & Santa Fe, has organized the Santa Fe Historical Society, and will endeavor to obtain records from every division and collect all interesting facts connected with the early history of the railway.

A steel freight car ladder that meets the requirements of the Interstate Commerce Commission safety appliances is being tested by the Pennsylvania Railroad. It is made of pressed steel, it is light and can be easily removed from the car by taking out three or four bolts which hold it.

The eight-hour day that has been in vogue in the locomotive shops of the Atchison, Topeka & Santa Fe at Topeka, Kan., has been abolished, and the shops are now working on a nine-hour basis. The passenger car shops are working eight and nine hours and the freight car shops ten hours.

The recent action of the Pennsylvania Railroad in prohibiting the sale of liquor on its trains in the state of Pennsylvania is said to mean that soon liquor will not be sold on the trains between New York and Chicago. It is expected that other railways in the state will adopt the same practice.

A complete file of the proceedings of the American Railway Master Mechanics' Association, and a collection of miscellaneous volumes of interest to the Department of Railway Engineering, has been presented to the library of the University of Illinois by Jacob Johann, of Springfield, Ill., who has for many years been identified with the Illinois Central.

John Mitchell was sentenced to nine months' imprisonment for contempt of court in connection with the Bucks Stove & Range Company case in the district court at Washington, July 23. Mr. Mitchell is vice-president of the American Federation of Labor, and an appeal to this sentence was taken, as in the cases of Samuel Gompers, the president of the Federation, and Frank Morrison, the secretary.

Sid Paul, locomotive engineer on the Pecos division of the Atchison, Topeka & Santa Fe, has been commended on his fuel performance in freight service. Mr. Paul made 1,852 miles on an average consumption of 12.81 lbs. of coal per 100-ton miles, as compared with the district average of 13.77 lbs. It is figured that during the eight months, from September to May, inclusive, Mr. Paul has saved $206.66 in this way.

The University of Illinois has published in bulletin form the address by C. A. Seley on the Conference Committee Methods in Handling Railway Legislation on Mechanical Matters; an address by H. M. Byllesby on Organization in Engineering, and an address by C. F. Loweth on Personal Efficiency, which are numbered 25, 27 and 28, respectively. These addresses were delivered to the College of Engineering in the early part of this year.

In furtherance of a plan of fuel economy, the Wabash has placed inspectors at the different mines from which the company receives its coal, and fuel service supervisors in each of the nine operating districts into which the system is divided. These supervisors will instruct firemen in the best methods of firing, and investigation will be made of the various grades of coal and their use in locomotives of different types. Lectures on fuel economy will be given at stated periods at the various division headquarters.

A "Safety Rally" will be held September 14 at Kansas City, Mo., by the railways entering that place. Eight thousand employees will be invited with the members of their families. The program will include addresses by railway officials on the causes of accidents, and moving pictures will be shown, illustrating the careless and safe methods of performing the various duties of railway employees. W. B. Spaulding, claims attorney of the St. Louis & San Francisco, will have charge of the moving pictures, and addresses will be made by Gardiner Lathrop, general solicitor of the Atchison, Topeka & Santa Fe; J. D. M. Hamilton, claims attorney of the Atchison, Topeka & Santa Fe, and R. C. Richards, general claims agent of the Chicago & Northwestern.

The Denver & Rio Grande put into effect July 1 a safety organization which consists of a central safety committee, division committees and shop committees. Their aim is to correct all conditions, customs and practices that are dangerous. E. N. Clark, general attorney of the road, is chairman of the general safety committee, which is further made up of the superintendent of motive power, general superintendent of the Colorado lines, general superintendent of the Utah lines, chief engineer, chief surgeon, claim agent and inspector of transportation. The shop safety committees will include the master mechanic, as chairman; a representative of the store department, a boiler maker, a machinist, a blacksmith and a car department representative. The central committee will have continuous service, but members of the division and shop committees will be appointed for a term of six months. All members of the committees will be supplied with a neat button indicating their capacity.

The Department of Industrial Research of the University of Pittsburgh, Pittsburgh, Pa., was provided with funds by a Pittsburgh business man in the fall of 1911, with which to make a thorough investigation of the smoke nuisance. A staff of experts have been giving considerable time to this investigation, making studies of the effect of smoke and soot on the atmosphere, weather, plant life, buildings, public health, the economic damage done by smoke and soot, and the mechanical devices for preventing or abating smoke. With the experience obtained from these studies the department announces that the members of its staff are prepared to lecture on the following phases of the smoke problem: The Smoke Nuisance (a general presentation of the main phases of the subject); Smoke and the Public Health; Smoke and the Cost of Living; Smoke and Plant Life; Methods and Means of Smoke Abatement; The Effect of Smoke on Buildings and Building Materials; the Psychology of Smoke; and the Smoke Nuisance and the Housekeeper. All correspondence should be directed to Dr. R. C. Benner, department of industrial research, University of Pittsburgh, Pittsburgh, Pa.

A bill has been passed by the House of Representatives creating the Department of Labor, the head of which will be a member of the President's cabinet. The purpose of the department is to guard and promote the welfare of the wage-earners and to improve their working conditions and opportunities. It is expected, however, that there will be some opposition to the bill in the Senate, partly on the ground that there is no reason to suppose that such a department would do more favorable work in connection with labor matters than the present Department of Commerce and Labor is doing. The House bill, concerning a commission of nine members, not less than three of whom are to be employers and three representatives of organized labor, to

inquire into the condition of labor in the principal industries of the country, has been favorably decided upon by the Senate Labor Committee.

MEETINGS AND CONVENTIONS

Master Blacksmiths' Association.—The twentieth annual convention of the International Railroad Master Blacksmiths' Association will be held at Hotel Sherman, Chicago, August 20-22, inclusive. The subjects to be considered are as follows: What Has the Association Accomplished During its Twenty Years of Existence; Flue Welding; Carbon and High Speed Steel; Drop Forgings; Frogs and Crossings; Case Hardening; Forging Machines, Dies and Formers; Spring Making and Repairing; Locomotive Frame Making and Repairing; Piece Work and Other Methods of Having Work Done; Shop Kinks; Oxy-Acetylene Process for Welding and Cutting of Metals, and Heat Treatment of Metal. In addition to this, the president has issued a request to all members of the association to present subjects that they are definitely interested in and will be of interest to the association.

Master Painters' Association.—The forty-third annual convention of the Master Car & Locomotive Painters' Association of the United States and Canada will be held in the Albany hotel at Denver, Col., September 10-13, inclusive. Among the subjects to be considered are: The Finish of Vestibule Ends; the Essentials of a Protective Paint Making Oil; Interior Car Renovators; the Most Economical Method of Removing Paint from Locomtive Jackets; Passenger Car Concrete Floors; Care of Steel Passenger Car Roofs; Standard Paint Material for Railway Equipment; Exterior Passenger Car Painting; the Present Day Foreman Painter; the Treatment of Ash, Oak or Mahogany Natural Finish; Relative Cost of Maintenance Between Steel and Wooden Passenger Cars, and the Painting of Wooden Freight Car Roofs. Arrangements have been made for a special train which will leave over the Rock Island Lines from Chicago to Denver, by way of Colorado Springs, on Saturday, September 7, at 10:30 p. m. The train will arrive in Colorado Springs early Monday morning, so that the day may be spent on sight seeing, and will leave at 7 p. m., arriving at Denver about 10 p. m.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass. 1913 convention to be held at St. Louis, Mo.

American Railway Master Mechanics' Assoc.—J. W. Taylor, Old Colony building, Chicago.

American Railway Tool Foremen's Association.—A. R. Davis, Central of Georgia, Macon, Ga.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. 39th St., New York.

Car Foremen's Association of Chicago.—Aaron Kline, 841 North 50th Court, Chicago; 2d Monday in month, Chicago.

International Railway Fuel Association.—C. G. Hall, McCormick building, Chicago.

International Railway General Foremen's Association.—William Hall, Chicago & North Western, Escanaba, Mich.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, Lima, Ohio. Convention, August 20, Sherman Hotel, Chicago.

Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty St., New York.

Master Car Builders' Association.—J. W. Taylor, Old Colony building, Chicago.

Master Car and Locomotive Painters' Assoc. of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention, September 10-13, Albany Hotel, Denver, Col.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Convention, August 27-30, Sherman Hotel, Chicago.

PERSONALS

GENERAL.

H. E. Pendleton, road foreman of engines of the Atchison, Topeka & Santa Fe at Belen, N. Mex., has resigned.

T. F. Sullivan, division master mechanic of the San Antonio & Aransas Pass, with office at Yoakum, Tex., has resigned.

W. D. Johnston, division master mechanic of the International & Great Northern, with office at Palestine, Tex., has resigned.

J. E. Sentman has been appointed road foreman of engines of the Baltimore & Ohio, in charge of the locomotives between Philadelphia and Baltimore, Md.

H. Osborne has been appointed assistant superintendent of motive power of the Canadian Pacific, with offices at Montreal, Que., succeeding L. R. Johnson.

J. F. McDonough, master mechanic of the Atchison, Topeka & Santa Fe at Newton, Kan., has been transferred to Shopton, Iowa, succeeding J. R. Sexton, promoted.

I. Wellman, road foreman of engines of the Atchison, Topeka & Santa Fe at Argentina, Kan., has been appointed master mechanic, with office at Newton, Kan.

J. R. Sexton has been promoted to mechanical superintendent of the Northern district of the Western lines of the Atchison, Topeka & Santa Fe, with office at La Junta, Col.

John C. Brennan has been appointed road foreman of engines on the Adirondack division of the New York Central & Hudson River, vice N. J. Graves, assigned to other duties.

L. R. Johnson, assistant superintendent of motive power, eastern lines, of the Canadian Pacific at Montreal, Que., has been appointed general superintendent of the Angus shops district.

A. L. Crew has been appointed road foreman of engines of the Los Angeles division of the Atchison, Topeka & Santa Fe, with headquarters at San Bernardino, Cal., vice Walter Reed, retired.

J. D. Young, general foreman of the Missouri Pacific, at Atchison, Kan., has been appointed master mechanic of the Omaha division, with office at Falls City, Neb., succeeding W. G. Seibert.

W. G. Seibert, master mechanic of the Omaha division of the Missouri Pacific, at Fall City, Neb., has been appointed master mechanic of the Colorado division, with office at Hoisington, Kan.

Frank Zeleny, assistant to the superintendent of shops of the Chicago, Burlington & Quincy at Aurora, Ill., has been appointed engineer of tests, with office at Aurora, succeeding William A. Derby, deceased.

W. C. Smith, master mechanic of the Missouri Pacific-St. Louis, Iron Mountain & Southern, with office at Kansas City, has been appointed general master mechanic of the Western district, with office at Kansas City.

T. Rumney, who is assistant second vice-president of the Rock Island Lines at Chicago, has also been appointed assistant vice-president in charge of mechanical matters of the St. Paul & Kansas City Short Line.

E. F. Stroeh, master mechanic, Colorado division of the Missouri Pacific, at Hoisington, Kan., has been appointed master mechanic of the Kansas City Terminal division, with office at Kansas City, Mo., succeeding W. C. Smith, promoted.

D. W. CUNNINGHAM, assistant superintendent of machinery of the Southern district of the Missouri Pacific, Iron Mountain & Southern, with office at Little Rock, Ark., has had his title changed to general master mechanic; his duties, however, will be the same as heretofore.

J. R. SEXTON, master mechanic of the Missouri division and the Shopton shops of the Atchison, Topeka & Santa Fe at Shopton, Iowa, has been appointed mechanical superintendent of the Western lines, Northern district, with office at La Junta, Colo., succeeding M. J. Drury, promoted.

J. P. MCMURRAY, who has been appointed master mechanic of the Rio Grande division of the Atchison, Topeka & Santa Fe, with office at Albuquerque, N. Mex., as announced in the July *American Engineer*, was born August 21, 1858. He began railway work as a wiper for the Atchison, Topeka & Santa Fe at Pueblo, Colo., in October, 1877, and has been with that road ever since. He was made locomotive fireman at Pueblo in 1878, and three years later was made locomotive engineer on the Rio Grande division at San Marcial. In January, 1903, he was promoted to road foreman of engines on the Rio Grande division and the Third district of the New Mexico division. He subsequently held the same position on the Western division, the River division and the Colorado division, and was promoted to master mechanic on May 15, 1912.

J. P. McMurray.

J. B. KILPATRICK, district mechanical superintendent of the Chicago, Rock Island & Pacific at Des Moines, Iowa, has been also appointed mechanical superintendent of the St. Paul & Kansas City Short Line, the position of superintendent of motive power of that road having been abolished.

W. L. TRACY, assistant superintendent of machinery of the Western district of the Missouri Pacific-St. Louis, Iron Mountain & Southern, with office at Kansas City, Mo., has been appointed general master mechanic of the Eastern district, with office at St. Louis, Mo. The office of assistant superintendent of machinery has been abolished, and the duties of these officers will be assumed by the general master mechanic.

R. J. TURNBULL, acting superintendent of machinery of the eastern district of the Missouri Pacific-St. Louis, Iron Mountain & Southern, with office at St. Louis, has been appointed mechanical superintendent of the entire Missouri Pacific-St. Louis, Iron Mountain & Southern, with office at St. Louis. The office of superintendent of machinery has been abolished and the duties heretofore performed by that officer have been assumed by the mechanical superintendent.

PURCHASING AND STOREKEEPING.

C. J. ROGERS, acting purchasing agent of the White Pass & Yukon Route at Vancouver, B. C., has been appointed purchasing agent, with office at Vancouver.

J. A. STRUBEL, assistant to the receivers of the Detroit, Toledo & Ironton at Detroit, Mich., has been appointed assistant to the receiver and purchasing agent, with office at Detroit.

BERTON ALLEN AIKENS has been appointed purchasing agent of the Michigan Central, with office at Detroit, Mich. Mr. Aikens was born August 25, 1869, at Hartford, Vt., and he received a public school education. He began railway work on April 1, 1889, with the Central Vermont Railroad. On April 1, 1899, he became a clerk in the office of the purchasing agent of the Rutland Railroad, was subsequently chief clerk in that office, then assistant storekeeper, and on February 1, 1905, was promoted to purchasing agent, which office he resigned on July 1 to become purchasing agent of the Michigan Central, and, effective July 11, to become also general tie agent of that road, the Lake Shore & Michigan Southern; the Lake Erie & Western; the Lake Erie, Alliance & Wheeling; the Cleveland, Cincinnati, Chicago & St. Louis; the Peoria & Eastern, the Cincinnati Northern; the Toledo & Ohio Central; the Zanesville & Western, and the Chicago, Indiana & Southern.

B. A. Aikens.

SHOP

E. W. TUCKER, pipe shop foreman of the Atchison, Topeka & Santa Fe at Colvis, N. Mex., has resigned.

THOMAS MULVIHILL has been appointed boiler foreman of the Chicago, Rock Island & Pacific at Argenta, Ark.

J. TANGNEY has been appointed foreman of the locomotive and car department at Inver Grove, Minn., vice E. A. Sweeley, resigned.

G. L. HEGBERG has been appointed night engine house foreman of the Chicago, Rock Island & Pacific at Argenta, Ark., vice C. A. Welch.

T. A. MERRIFIELD has been appointed boiler foreman of the Atchison, Topeka & Santa Fe at Las Vegas, Nev., vice W. J. Doerfler, resigned.

H. C. CURTAIN, night engine house foreman of the Atchison, Topeka & Santa Fe at Needles, Cal., has been appointed day engine house foreman at Barstow.

J. C. BEVELLE, apprentice instructor of the Atchison, Topeka & Santa Fe at Topeka, Kan., has resigned to go with the El Paso & Southwestern, at El Paso, Tex., as tool foreman.

W. H. GABLE has been appointed assistant engine house foreman of the Minneapolis, St. Paul & Sault Ste. Marie at North Fond du Lac, Wis., vice C. A. Bauers, transferred.

E. ZIMMER, former engine house foreman of the Minneapolis, St. Paul & Sault Ste. Marie, has been transferred to North Fond du Lac, Wis., vice L. Colburn, resigned.

C. A. BAUERS, former assistant engine house foreman of the Minneapolis, St. Paul & Sault Ste. Marie, has been appointed engine house foreman at Stevens Point, Wis., vice E. Zimmer, transferred.

NEW SHOPS

Canadian Pacific.—The town of Trenton, Ont., has given this road a free site for an engine house and station, on the condition that Trenton is made a division point.

Central Vermont.—The repair shops at St. Albans, Vt., will be enlarged.

Chicago, Peoria & St. Louis.—The shops at Jacksonville, Ill., will be removed to Springfield by October 1.

Cleveland, Cincinnati, Chicago & St. Louis.—A new five-stall engine house will be built at Carey, Ohio; a 10-stall engine house at Hillsboro, Ill., and a 10-stall brick engine house at Terre Haute, Ind.

Georgia Southern & Florida.—A drop pit shop will be built at Macon, Ga., for locomotive repairs.

Grand Trunk.—It is reported that large locomotive shops will be built at Brockville, Ont.

Illinois Central.—The contracts for the new engine terminal at Centralia, Ill., have been awarded. They include a 48-stall engine house, an erecting shop, power house, machine shop, car repair shop, mechanical coaling station, three cinder pits, an inspection pit and two water tanks. The contract for building construction has been awarded to T. S. Leake & Company, Chicago.

Lake Erie & Western.—Improvements will be made in the shops at Rankin, Ill., and additional power equipment will be installed.

Missouri, Oklahoma & Gulf.—It is reported that $400,000 will be spent on new shops of steel, brick and concrete construction at Muskogee, Okla. They will include a machine, repair and boiler shop, transfer table and engine house.

New York, Ontario & Western.—The car shops at Middletown, N. Y., were destroyed by fire July 3. The estimated loss is $250,000. They will be rebuilt.

Norfolk & Western.—It is reported that a 25-stall engine house will be built at Crewe, Va., at a cost of about $50,000.

Northern Pacific.—It is reported that a car wheel shop will be erected at Missoula, Mont.

Pere Marquette.—A contract has been awarded to Hauser-Owen-Ames Company, Grand Rapids, Mich., for a 16-stall engine house at Ludington, Mich., that will cost approximately $50,000. The contract for the 12-stall engine house at Port Huron, Mich., has been awarded to Rabbit & Sons, Toledo, Ohio, to cost approximately $40,000. The contract for the coaling station at Saginaw, Mich., has been awarded to the Fairbanks, Morse & Company, Chicago, the approximate cost being $50,000.

Virginian.—It is reported that contracts have been let for an eight-stall addition to the engine house at Roanoke, Va., and Victoria.

Wabash Railroad.—The contract for a complete engine terminal at Detroit, Mich., to cost $100,000, has been awarded to C. W. Gindele & Company, Chicago.

Western Pacific.—The work that was suspended on the shops at Sacramento, Cal., will be resumed and the shops will soon be completed.

Telegraph Service Record.—According to an officer of the Western Union Telegraph Company, the *Titanic* tragedy produced the greatest volume of telegraphic communication of any single event in history. The day the *Carpathia* reached New York, Western Union wires handled 715,000 words (of press matter) compared with a previous high record for a single day of 433,000.

SUPPLY TRADE NOTES

Isaac Block, president of the Hyman-Michaels Company, Chicago, died July 10.

The Chicago Steel Car Company has moved its general offices from Chicago to its plant at Harvey, Ill.

The Jerguson Manufacturing Company, Boston, has moved its general office from 221 Columbus avenue to 10 Post Office Square.

The Davenport Locomotive Works, Davenport, Iowa, has opened an office in the First National Bank building, Cincinnati, Ohio.

Harry N. Turner has been made eastern railway representative of the Kay & Ess Company, Dayton, Ohio, succeeding D. L. Paulus, who died at his home in Atlantic City, N. J., June 20.

The Railway Motor Car Company, Marion, Ind., has been incorporated with W. P. Worth, J. D. Worth, H. B. Shore, G. R. Stewart and Eben H. Wolcott, as directors. The capital stock is $200,000.

The Brownell Company, Dayton, Ohio, maker of automatic and throttling engines, boilers, feed water heaters, etc., has opened a branch office in the Oliver building, Pittsburgh, Pa., in charge of B. S. Rederer.

F. T. Heffelfinger has been elected vice-president of the American Arch Company, New York, succeeding C. B. Moore, who has resigned to go to the Jacobs-Shupert United States Firebox Company, Coatesville, Pa.

The new plant of the Canadian Steel Foundries, at Longue Pointe, Que., is ready for operation. This concern is a subsidiary of the Canadian Car & Foundry Company, and it is the largest producer of steel castings in Canada.

E. P. Williams, purchasing agent of the Baldwin Locomotive Works, Philadelphia, Pa., has been appointed assistant to the vice-president. Mr. Williams held his former position for 25 years and will be succeeded by John Lindauer, Jr.

The Warner & Swasey Company, Cleveland, Ohio, has petitioned to increase its capital stock from $500,000 to $1,000,000. The company contemplates the construction of an additional building on the east side of its present structures.

W. H. Davis, formerly with the Scully Steel & Iron Company, Chicago, has gone with the Jos. T. Ryerson & Son, Chicago, with office in New York. Mr. Davis will be especially interested in the machinery sales department.

F. H. Stevens, a member of the executive committee of the American Locomotive Company, New York, has been elected director of the United States Cast Iron Pipe & Foundry Company, Burlington, N. J., succeeding John A. Hayes.

Templeton, Kenly & Company, Ltd., Chicago, have moved their Chicago offices and shops from 1335 Sloan street to their new plant at 1016-1024 South Central avenue. A switch from the Baltimore & Ohio Chicago Terminal connects with this plant.

The Vulcan Engineering Sales Company, Chicago, has taken the selling agency for the line of structural and plate working machinery, such as punchers, shears, rolls, bulldozers, etc., manufactured by the Rock River Machine Company, of Janesville, Wis.

W. L. Allison, of the Franklin Railway Supply Company, New York, with office at Detroit, Mich., has been made general Western sales manager of the American Arch Company, New York, with office in the McCormick building, Chicago. Mr. Allison will represent both companies.

Louis E. Carlton, president of the Heywood Brothers & Wakefield Company, Wakefield, Mass., died at his home in

Gardner, Mass., July 4, at the age of 50. Mr. Carlton was also president of the First National Bank of Gardner, and was a delegate to the National Republican Convention in 1908.

The U. S. Metal & Manufacturing Company, New York, will no longer act as agent for axles made by the Carbon Steel Company, Pittsburgh, Pa. On July 1 the company took over the account of the Pollak Steel Company, Cincinnati, Ohio, manufacturer of heat-treated traction axles, tender and driving axles, crank pins, side and driving rods, equalizers; etc.

The Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.; the Equitable Trust Company, New York; the Stone & Webster Corporation, Boston, Mass., and William Morris Imbrie & Company, New York, have formed a syndicate to purchase the controlling interest in the Electric Properties Company, New York, from the Westinghouse Machine Company, Pittsburgh, Pa.

The following companies, which are controlled by the same interests, have moved their general offices to the new Vanadium building, Forbes and Meyran avenues, Pittsburgh, Pa.: The American Vanadium Company; the Vanadium Sales Company of America; the Flannery Bolt Company; the Vanadium Metals Company; the J. Rogers Flannery & Company, and the Keystone Nut Lock Manufacturing Company.

John Gill, a former superintendent of motive power of the Chicago, Indianapolis & Louisville, has been appointed manager of the Permanent Manufacturers' Exhibit of Railway Supplies and Equipment, in the Karpen building, Chicago. Mr. Gill is thoroughly conversant with the mechanical department of railways, having worked his way from a machinist apprentice to superintendent of motive power, as above stated.

The National Steel Car Company, Ltd., Hamilton, Ont., has been organized with a capital of $6,000,000, and will erect a car building plant on a 50-acre site on the water front east of Hamilton, where the company will make wooden and steel freight cars. The capacity of the plant for the present will be 30 cars a day, which will later be increased. The officials of the company are as follows: President, Sir John Gibson, lieutenant-governor of Ontario; vice-president and general manager, Basil Magor, of New York; assistant secretary, treasurer and purchasing agent, Adolph Butze. The directors are Sir John Gibson, William Southam, and J. J. Scott, all of Hamilton; Sir H. Pellatt, of Toronto, Ont.; W. G. Ross, Mortimer Davis and C. H. Cahan, all of Montreal; William Barclay Parsons, W. Kirkpatrick Brice, Murray H. Coggleshall and Basil Magor, all of New York. The company has placed contracts for its steel work, and all contracts are being let for completion not later than November of this year. The main plant will be 900 ft. x 200 ft. The general offices will be at Montreal, Que.

The Lima Locomotive & Machine Company, Lima, Ohio, has been reorganized as the Lima Locomotive Corporation. The new corporation has sold to Redmond & Company, New York, the entire issue of $2,000,000 first mortgage 20-year sinking fund gold bonds, callable at 110, on any interest date, the proceeds of which will be used for the erection of additional buildings, purchase of equipment and for working capital. The new plant will provide employment for 4,000 men. For many years the old company made only geared locomotives, but during the past ten years it has steadily increased its output of locomotives of all classes until further extensions have become necessary. The new corporation owns 43 acres of land at Lima, Ohio, on which there is a modern plant, having a capacity of 400 engines per year. This capacity will be increased to 900 or 1,000 locomotives a year. The net earnings for the past seven years, after deducting for depreciation, have averaged two and a third times the interest on the new bonds. The directors are: A. L. White, Ira P. Carnes, W. T. Agerter, O. J. Thomen, George L. Wall and Merle Middleton, who is chairman of the board. The company will be under the management of the same official staff as heretofore with the officers as follows: President, A. L. White; vice-president, George L. Wall; secretary and treasurer, W. T. Agerter.

Gilbert H. Pearsall, secretary of Joseph T. Ryerson & Son, Chicago, has been made a vice-president of the Jacobs-Shupert United States Firebox Company, Coatesville, Pa., and Charles Brearley Moore, vice-president of the American Arch Company, New York, has resigned that position to become a vice-president of the Jacobs-Shupert Company. Mr. Pearsall will be in charge of the New York office of the Jacobs-Shupert company. He still retains his position as secretary of the Ryerson company, with which concern he has been connected since May, 1901. Since January 1, 1905, he has been in general charge of the sales of that company. In 1887 Mr. Pearsall entered the service of the Erie, with office at Owego, N. Y. From 1891 to 1897 he was chief rate clerk of the Chicago, Burlington & Quincy, and from 1897 to 1899 he was chief clerk in the traffic manager's office of the Indiana, Illinois & Iowa, now a part of the New York Central Lines. From 1899 and 1901 he was city freight agent and freight agent of the Delaware, Lackawanna & Western. In May, 1901, he resigned his position with that road to go to the Ryerson company. Mr. Moore will have charge of the western sales department of the Jacobs-Shupert company, with office in Chicago. He was born in McComb, Ill., in 1874, and received his primary education in the public schools, graduating in 1891 from the Kewanee, Ill., high school. In 1895 he was graduated from the Lake Forest University and then went to the Northwestern University law school from which he was graduated in 1898. In 1900 he organized the Columbia Boiler Company to make house heating apparatus and boilers. In 1902 he organized the American Locomotive Equipment Company, of which he was general manager and a director until 1911, when he was made president of the company. Mr. Moore shared in the organization of the American Arch Company in 1910 and was made vice-president and a director of that company. In 1911 he organized the Boss Nutt Company, Chicago, of which he is now a director. Mr. Moore has invented and developed a number of locomotive devices, of which his brick arch is the best known.

G. H. Pearsall.

C. B. Moore.

CATALOGS

Car Appliances.—The Wine Railway Appliance Company, Toledo, Ohio, has issued a brief catalog describing their steel car ladders and freight car ventilators.

Snow Flanger.—The Railway Appliance Company, Chicago, has issued an 8-page pamphlet illustrating their various types of snow flangers as applied to locomotives in service.

Forged Steel Valves.—The Patterson-Allen Engineering Company, New York, has published a folder describing their forged steel valves, giving the price list and table of dimensions for the various sizes.

Kerosene Gas Engines.—The Wisconsin Engine Company, Corliss, Wis., has published a leaflet giving a general description of its kerosene gas engines. This company builds these engines of from 50 to 200 h. p. capacity.

Wire Glass.—The Pennsylvania Wire Glass Company, Philadelphia, Pa., has issued a catalog describing their cobweb wire glass, its uses and advantages in building construction. Fire tests that have been made on this glass are also included.

Turbines.—The Kerr Turbine Company, Wellsville, N. Y., has published bulletin No. 24 on the Economy steam turbine for belt drive. This bulletin illustrates installations and describes the construction of these turbines and points out their advantages.

Roofing.—The Barrett Manufacturing Company, New York, has issued a catalog entitled A Mile of Barrett Specification Roofs, which apply to the installation at the Bush terminals in Brooklyn. The total roof area of these buildings is 3,100,000 sq. ft., or more than 70 acres, which is covered with the Barrett specification type roofs.

Transformers.—The Crocker-Wheeler Company, Ampere, N. J., has issued bulletin No. 151, which describes and illustrates the Remek distributing transformers. Various processes in manufacture are illustrated and the detailed construction is explained. One of the special advantages of the Remek type of transformer is in the low average core loss.

Small Motors.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 4963, which describes small motors ranging in size from 1/50 to ¼ h. p. wound for either direct or alternating current. The illustrations show the completed motors and various processes used in manufacture, together with structural details and typical installations.

Chains.—The Jones & Laughlin Steel Company, Pittsburgh, Pa., has issued a clearly illustrated leather bound catalog describing their various types of chains and hooks, together with a brief description of their manufacture and maintenance. Tables are also given of tests and weights of the various grades of their chains. Special chains and attachments are also illustrated.

Oxy-Acetylene Welding and Cutting.—The Alexander Milburn Company, Baltimore, Md., has issued a well illustrated catalog of 23 pages describing the work that may be done with their welding and cutting apparatus. The acetylene generator and oxy-acetylene torch are also described and illustrated. A price list of their various outfits and stock list is included in a separate folder.

Draft Gears.—The Forsyth Bros. Company, Chicago, have issued a 24-page pamphlet entitled the "Modern Connections Between Drawbars and Draft Gears," in which they quote from the proceedings of the M. C. B. association concerning drawbar side clearance. Various illustrations are included which show graphically the faults of a restricted side clearance, and their improved radial yoke which tends to decrease side clearance restrictions.

Pneumatic Hammer-Drill.—The Ingersoll Rand Company, New York City, has issued form No. 4021, which describes the new type BCR-43 Jackhamer. This machine is a new development of the hand hammer drills and is designed to operate with either steam or air. It is automatically rotated, being equipped with the butterfly value, a simple piece of steel oscillating on a central trunnion actuated by the unbalanced pressure on the wings. The drill has a cylinder 2¼ in. in diameter and a 2 in. stroke.

Electric Locomotives.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has published a 64-page catalog entitled Baldwin-Westinghouse Electric Locomotives. It is quite complete, and includes various illustrations showing the different types of electric locomotives and many of their details. A brief history is given of the modern railway motor, with illustrations of the improved details in design. The unit switch control system is discussed, as is the design of cabs, underframes, trucks, wheels, journals, special equipment, etc. A few pages are devoted to data concerning the selection of electric locomotives, their operation on curved track and train resistance.

Fuel Economizer.—The Green Fuel Economizer Company, Matteawan, N. Y., has issued catalog No. 142, which contains 104 pages and gives data that would be of service to power plant engineers. The function of the economizer is discussed and the amount of heat that has been saved in specific cases is also given. Various installations are illustrated, as are charts describing their efficiency. The details of this economizer are also illustrated and described and specification dimensions are given for the different sizes of economizers. A steam table from zero to 350 lbs, absolute pressure is included

Superheaters.—The Locomotive Superheater Company, New York, has issued a 28-page catalog which gives a brief history of locomotive superheaters, together with the advantages that are now obtained by their use. Several examples of installations that have given increased hauling power with a decrease in the fuel consumption are noted, and various illustrations are given which clearly describe the various parts of the superheater, as well as the operation of the various types. A statement of the number of superheaters ordered to June 1, 1912, accompanies this catalog and shows that there are 4,505 superheaters in service and under construction.

Throttle Valve.—The Watson-Stillman Company, New York, has issued catalog No. 86, which describes the Chambers throttle valve. The feature of this valve is that it is opened by turning the valve rod instead of pulling it in the ordinary way. It does away with the necessity of numerous levers in the throttle pipe, and is operated by rotating a crank. Among the claims presented for this valve are, the increased room in the dome for inspection, decreased liability of failure on account of there being a less number of parts, that steam may be taken from a higher point in the dome, the ease of operating, and the ease of regulating the opening of the valve.

Vanadium Steel.—The American Vanadium Company, Pittsburgh, Pa., has issued an 80-page catalog, which is clearly illustrated and contains data and information that will be acceptable to engineers using this class of steel. A brief historical account precedes a more technical discussion of this steel. The effect of Vanadium in steel is spoken of, together with its strength, hardness and heat treatment, the latter including several illustrations of metallurgical photographs. The various types of Vanadium steel from A to K are described and their chemical contents given, together with their physical properties. Nickel chrome Vanadium steel and carbon Vanadium tool steel are next considered, as are the various methods of manufacture. The catalog closes with a discussion of the use of Vanadium in cast iron and the various applications of all the types of Vanadium steel. It is quite complete and would be a valuable book for one's library.